USDA FOREST SERVICE, SAN JUAN NATIONAL FOREST, DOLORES RANGER DISTRICT

Hydrology Report for the Glade Landscape EIS

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Contents

Climate

The weather station nearest the Glade landscape with the most complete data is located at Cortez, CO. Between 1940 and 2013, average annual precipitation at Cortez was 12.67 inches. The maximum annual precipitation occurred in 1957 measuring 26.34 inches. The minimum annual precipitation occurred in 1989 measuring 5.23 inches. Mimicking a pattern reflected across the contiguous 48 states (EPA, 2002), ten of the fourteen years between 1999 and 2013 had less than average rainfall. Two nearby stations, Dolores and Yellow Jacket, show slightly higher rainfall amounts due to increases in elevation but very similar weather patterns. Dolores' mean annual precipitation measures 18.86 inches, with a maximum of 31.97 inches occurring in 1957 and a minimum of 11.58 inches occurring in 1989. Yellow Jacket only has a period of record from 1963 to 2002. During this time, Yellow Jacket's mean annual precipitation was15.52 inches with a maximum precipitation of 23.68 inches in 1965 and a minimum precipitation of 7.6 inches in 1989. The Glade landscape is higher in elevation than Cortez, Dolores, and Yellow Jacket so average annual rainfall would have been slightly higher between 1940 and 2013 but weather patterns would have been similar.

Average annual temperature between 1940 and 2013 in Cortez was 49.3°F. The maximum annual temperature was 52.8°F while the minimum annual temperature was 47.4°F showing relatively little fluctuation in temperatures from year to year. Temperature data for Yellow Jacket shows a similar pattern. Temperature data for Dolores was insufficient to generate comparable averages. Temperatures on the Glade would have been slightly cooler with similar minimal fluctuations in annual averages from year to year.

Weather patterns and conditions that result in a deficiency of precipitation, high evapotranspiration, and decreased runoff are categorized as drought conditions. A common measure of drought conditions is the Palmer Drought Severity Index (PDSI). According to historic PDSI records which began in 1895, the 1930s and the 1950s saw the most severe and widespread droughts across the nation while the last 50 years have generally been wetter than average (EPA, 2002) even when factoring in recent drought conditions. Furthermore, in comparing the 20th century to the previous centuries (1550-1850), the 20th century can be characterized in general as having warmer and wetter conditions (Romme, Floyd, and Hanna, 2009). For example, the period from 1976-1995 was one of the wettest in the Southwestern United States in the last thousand years (Romme, Floyd, & Hanna, 2009). Looking ahead however, geospatial climate forecast data predict that the 21st century is expected to have warmer than average temperatures and variable precipitation across the United States (TACCIMO, 2013). Geospatial climate forecast models run specifically for Dolores County, CO predict an average temperature increase between 2.3°C and 3°C and an average decrease in precipitation between 4.1 mm and 4.8 mm (TACCIMO, 2013). In addition, current trends for southwestern Colorado point to less precipitation in the form of snow, overall reductions in snowpack, and earlier spring snowmelt (EPA, 2002). Thus, while the last century and the last 50 years on average were warmer and wetter than previous centuries, the future is predicted to be warmer and drier thereby increasing the likelihood of more persistent drought conditions.

Watershed/Soil &Water Resources

Surface geology. The Glade landscape occurs within the physiographic province of the Colorado Plateau. The Colorado Plateau largely consists of thick horizontal beds of limestone, sandstone, siltstone, and shale that were laid down in shallow marine waters. The climate of the plateau is generally arid which facilitates the process of erosion; thus, the plateau is also made up of distinctive erosional features such as mesas, cuestas, rock terraces, retreating escarpments, canyons, and dry washes. The Glade landscape contains a number of these characteristic features.

The principal feature of the Glade landscape is a large mesa top. The mesa top consists predominantly of the Dakota and Burro Canyon formation to the south and the Dakota sandstone to the north. The Dakota and Burro Canyon formation is comprised of quartzitic sandstone and conglomerate sandstone with minor amounts of claystone, siltstone, shale, and mudstone and is light grey and light brown. The Dakota sandstone has a similar composition but is yellowish-brown to grey. The canyons to the west of the mesa cut predominantly through the Morrison formation on their way to the Dolores River valley. The Morrison formation is a distinctive sequence of sedimentary rock that is composed of mudstone, sandstone, siltstone and limestone and is light grey, greenish gray, or red. In the Dolores River valley the Dolores River traverses Quaternary alluvium that consists of silt, sand, and gravel. To the east and northeast of the Glade landscape the surface geology consists predominantly of Mancos shale. Mancos shale is cretaceous marine clay shale with thin platy beds of limestone and calcareous sandstone and is grey to dark grey. (See *Appendix A Glade landscape: Geology*.)

The Glade landscape is contained within the larger 4th level watershed called the Upper Dolores River. Within the Upper Dolores River watershed and intersecting the Glade landscape are the Plateau Creek, Disappointment Creek, McPhee Reservoir-Dolores River, and Ponderosa Gorge-Dolores River 5th level watersheds. Major drainages in the Glade landscape include Plateau Creek, Beaver Creek, Dry Canyon, Ryman Creek, Hunt Creek, Glade Canyon, Narraguinnep Canyon, Salter Canyon, and a portion of the Dolores River. (See *Appendix B Glade landscape: 5th level watersheds*; *Appendix C Glade landscape: Major drainages*.)

Watersheds that have more than 50% Mancos shale were identified in the San Juan National Forest Land and Resource Management Plan (RMP) as having a high potential for salinity issues. Within the Glade landscape those 6th level watersheds are: Upper Disappointment Valley, Summer Camp Creek-Plateau Creek, Calf Creek, Headwaters Plateau Creek, Ryman Creek, Hunt Creek-Disappointment Creek, and Sheep Camp Valley-Disappointment Creek (see *Appendix D Glade landscape: 6th level saline watersheds*). Ryman Creek consists of approximately 82% Mancos shale and the Headwaters Plateau Creek consists of 72% Mancos shale. Gully plugs and contour furrows were installed in various locations within the Ryman Unit of the Brumley allotment within the Ryman Creek watershed for the purpose of reducing soil erosion, reducing overland flow rates, and increasing water infiltration into the ground with secondary effects of salinity reduction. The plugs and furrows worked temporarily to reduce localized erosion but widespread erosion throughout the watershed continues. In addition to high potential for salinity issues, watersheds sensitive to anthropogenic disturbance were also been

identified in the RMP. Within the Glade landscape the Brumley Valley-Disappointment Creek watershed is a sensitive watershed.

Soils. The three predominant soil map units occurring on suitable grazing acres are the Jemco-Detra-Beje complex, the Granath-Fughes complex, and the Dolores-Fivepine complex. The Jemco-Detra-Beje map unit is a complex of shallow to deep, well drained soils on mesas, hills, and ridges. The unit consists of 40 percent Jemco silt loam, 30 percent Detra loam, 20 percent Beje loam, and 10 percent included soils. Slopes range from 1 to 15 percent. It is predominantly derived from sandstone. Infiltration rates are moderate to very slow, surface runoff is medium to high, and hazard of erosion by water is moderate (see *Appendix E Glade landscape: Soils*).

Table 1 Soil Classifications for the Glade landscape

Soil Classification	Acres occurring on suitable rangeland
Jemco-Detra-Beje complex, 1 to 15 percent slopes	19,017
Granath-Fughes complex, 0 to 15 percent slopes	13,304
Dolores-Fivepine complex, 0 to 15 percent slopes	10,896

The Granath-Fughes map unit is a complex of very shallow to very deep, well drained soils on hills and mesas. The unit consists of 50 percent Granath loam, 35 percent Fughes loam, and 15 percent included soils. Slopes range from 0 to 15 percent. Parent material for the Granath loam is eolian deposits derived from sandstone. Parent material for the Fughes loam is alluvium and/or slope alluvium derived from sandstone and shale. Infiltration rates are moderate to slow, surface runoff is medium to high, and hazard of erosion by water is moderate.

The Dolores-Fivepine map unit is a complex of shallow to very deep, well drained soils on hills and mesas. The unit consists of 50 percent Dolores loam, 35 percent Fivepine flaggy loam, and 15 percent included soils. Slopes range from 0 to 15 percent. Dolores parent material is slope alluvium derived from sandstone and Fivepine parent material is residuum and slope alluvium derived from sandstone. Soil infiltration rates are slow to very slow, surface runoff is very high, and hazard of erosion by water is low to moderate.

None of the three predominant soil map units contain soils that are prime farmland. None of the three predominant soil map units contain soils that are high in salinity. However, moderately saline soil does occur in the northeast portion of the Glade landscape within the Lillings silty clay loam soil map unit. The Lillings silty clay loam is a very deep, well-drained soil occurring along drainage ways and floodplains. The Lillings silty clay loam is prime farmland, if irrigated. Two other soil complexes within the Glade landscape have the potential to be prime farmland: the Wetherill loam, if irrigated and the Umbar-Winner-Tesajo complex, if irrigated and drained. Soils with the potential to be prime farmland comprise less than 1 percent of the Glade landscape.

Upland Hydrology. Upland hydrology was assessed in the Mair, Brumley, and Glade allotments using the following rangeland health indicators (USDI, 2005): gullies, water flow patterns, pedestals, compaction layer, and bare ground. In general, within the Mair allotment all hydrologic indicators show a none to slight departure from reference conditions across the landscape. Exceptions occur at reservoirs where bare ground and compaction layer show a slight to moderate or moderate to extreme departure from reference conditions. Within the Brumley

allotment bare ground is the most widespread issue with 10 out of 13 assessment locations having slight to moderate or moderate to extreme departures from reference conditions. Water flow patterns, pedestals, and compaction layer are less widespread but are slight to moderate or moderate to extremely departed from reference conditions in about half of the areas assessed. The hydrologic indicator with the least occurrence across the Brumley allotment is gullies. Gullies are a common feature in the Ryman pasture but relatively rare elsewhere in the allotment. Hydrologic indicators in the Glade allotment rated no more than a slight to moderate departure from reference conditions for all sites. Again, bare ground is the indicator most commonly departed from reference conditions. Least departed are gullies and compaction layer.
For the remainder of the allotments, general observations are that gullies are relatively rare and that bare ground is the most common issue across the landscape. Compaction layer is present around reservoirs but not common throughout the allotments. Water flow patterns and pedestals are present on portions of the landscape but at no more than a slight to moderate departure from reference conditions except on lower elevation pinon-juniper sites.

Desired conditions, standards, and guidelines. Desired conditions are derived from the Watershed Conservation Practices Handbook for Region 2 (WCP) and the RMP. The following management measure is outlined in the WCP:

- Maintain or improve long-term levels of organic matter and nutrients on all lands (14.2 Management Measure 14).

The following desired conditions are outlined in the LMP:

- Soil productivity is in tact on all riparian area and wetland ecosystems on the SJNF and TRFO. (DC 2.4.9)
- Long-term levels of soil organic matter and soil nutrients are maintained at acceptable elvels on all riparian area and wetland ecosystems of the SJNF and TRFO. (DC 2.4.10)
- Ground cover (vegetation and litter) is adequate to protect soils and prevent erosion on all riparian area and wetland ecosystems of the SJNF and TRFO. (DC 2.4.11)
- Long-term impacts to soils (e.g., soil erosion, soil compaction, soil displacement, puddling, and/or severely burned soils) from management actions are rare on all riparian area and wetland ecosystems of the SJNF and TRFO. (DC 2.4.12)
- Rangelands provide diverse, healthy, sustainable plant communities and conserve soil quality (DC 2.7.5)
- Upland areas function properly and do not contribute to stream-channel degradation (DC 2.6.12).

The following standard is outlined in the LMP:

- Agency actions should avoid or otherwise mitigate damage to the long-term soil productivity of riparian area and wetland ecosystems. (S 2.4.24)

The following guideline is outlined in the LMP:

- Rangeland management should incorporate measures to conserve soil quality. (S 2.7.24)

Water Quality

Beneficial uses and special designations. A portion of the Glade landscape is located within water quality control stream segments 4a, 4b, 11, and 15 of the Dolores River Basin (CDPHE-WQCD, September 2013, Regulation No. 34). These segments include the mainstem of the Dolores River from a point immediately below the confluence of the West Dolores River to the bridge at Bradfield Ranch, the tributaries to this segment of the Dolores River from their source to their confluence, and all wetlands, lakes and reservoirs, including McPhee Reservoir (see *Appendix F Glade landscape: Water quality*). Beneficial use classifications include Aquatic Life Cold 1 and 2, Recreation E, Water Supply, and Agriculture.

The remainder of the Glade landscape is located within water quality control stream segments 1a, 1b, 3a, 3b, and 7 of the Lower Dolores River Basin (CDPHE-WQCD, September 2013, Regulation No. 35). These segments include the mainstem of the Dolores River from the bridge at Bradfield Ranch to a point immediately above the Highway 141 road crossing near Slick Rock, CO, the tributaries to this segment of the Dolores River from their source to their confluence, and all wetlands, lakes and reservoirs, including Cabin Reservoir, Beef Trial Reservoir, Dry Lake, Glade Lake, and Glade Point Reservoir. Beneficial use classifications include Aquatic Life Cold 1, Aquatic Life Warm 2, Recreation E, Water Supply, and Agriculture. Surface waters in segment 3a are use protected. A use-protected designation which allows for some water quality degradation as long as parameters associated with use classifications continue to meet State water quality standards.

A designation of Water Supply indicates that surface waters are suitable or intended to become suitable for potable water supplies; it does not necessarily indicate that they are currently used for water supplies. However, several municipalities are served by surface waters originating on or traversing the Glade landscape. Those municipalities are Dolores, Cortez, Towoac, and Dove Creek. Only the waters draining to the north of the project area do not supply municipal water.

And finally, the Dolores River was designated through the LMP as suitable for inclusion in the Wild & Scenic Rivers Act from the dam at McPhee Reservoir to Bedrock, CO based on the presence of several Outstandingly Remarkable Values. The State of Colorado recognizes river segments with wild and scenic characteristics with a High Quality Water designation. Subsequently, segments4a, 4b, and 11 of the Dolores River Basin and segments 1a, 1b, and 7 of the Lower Dolores River Basin have High Quality Water designations.

Impaired and potentially impaired waters. Stream segments that are not fully supporting their designated beneficial uses by exceeding one or more numeric or narrative standards are defined as impaired and placed on the State's 303(d) List. McPhee Reservoir is listed as impaired for mercury in fish tissue. In addition to the List of Impaired Waters, there is a Monitoring and Evaluation (M&E) List, which identifies water bodies that are suspect of water quality problems, but uncertainty exists regarding several factors, such as reliability of the data. Disappointment Creek, a creek that receives stream flow from several drainages within the Glade landscape before entering the Dolores River, is listed on the M&E for selenium and E. Coli. And though not listed on the M& E, salinity levels are known to be high in Disappointment Creek and its tributaries.

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- Ground cover (vegetation and litter) is adequate to protect soils and prevent erosion on all riparian area and wetland ecosystems of the SJNF and TRFO. (DC 2.4.11)
- Long-term impacts to soils (e.g., soil erosion, soil compaction, soil displacement, puddling, and/or severely burned soils) from management actions are rare on all riparian area and wetland ecosystems of the SJNF and TRFO. (DC 2.4.12)
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Wetlands/Riparian Zones

Background information. Wetlands are areas that are saturated by surface or ground water. Vegetation that grows in wetlands is typically adapted for life in saturated soil conditions. Riparian areas, such as a stream bank, are a transition area between permanently saturated wetlands and upland areas. These areas can be detected on the landscape by their physical features and sometimes by their characteristic vegetation. Lands along perennially and intermittently flowing rivers and streams and the shores of lakes and reservoirs with stable water levels are typical riparian areas.

Riparian plant density and plant community development can vary based on saturation level of the soil. Natural and human-caused disturbance can also affect the plant community. A range of stages, from the absence of stabilizing plants to the presence of these plants to the development of riparian plant community complexes (ecological potential) are possible depending upon conditions. Obligate wetland plants are found in saturated soil conditions. Facultative wetland plants are found growing in areas where the soil is saturated more than half of the time. Upland species are generally found where soils tend not to be saturated. Table 2 describes wetland-riparian plants under different conditions.

Table 2 Wetland Indicator Status and Condition

Indicator Status	Condition
Obligate Wetland	Almost always occur in wetlands
Facultative Wetland	Usually occur in wetlands, but may occur in non-wetlands
Facultative	Occur in wetlands and non-wetlands
Facultative Upland	Usually occur in non-wetlands, but may occur in wetlands
Obligate Upland	Almost never occur in wetlands

Riparian habitat descriptions. The discussion to follow will describe the diversity of riparian habitats found across the Glade landscape. Descriptions will include physical/geomorphic features of the riparian-wetland areas and their associated riparian vegetation both under potential conditions and under changed conditions. Vegetation descriptions are taken from both the Field Guide to the Wetland and Riparian Plant Associations of Colorado (Carsey et al., 2003) and the Ecological Inventory of the Mair Allotment (Johnston, 1992). Changed conditions can be naturally occurring, such as drought, or the result of specific land use activities.

Low gradient swales/slope wetlands. The Glade landscape is predominantly mesa top that drops steeply down to the Dolores River on the west and Disappointment Creek on the north. On the mesa top are mostly low gradient swales (also called slope wetlands) that are saturated throughout much of the year. The saturated swales at potential are characterized by a dense swath of mountain rush with minor amounts of species such as water sedge, beaked sedge, and common spikerush and forb cover will be low. When altered, instead of a dense swath of rush and sedge, shrubby cinquefoil will dominate the site and species such as wild iris, dandelion and Kentucky bluegrass will establish or increase if already present. Some swales on the mesa top have downcut in addition to having a species composition change limiting the potential of the riparian width.

Glade Canyon. Also originating on the mesa top is Glade Canyon, a unique low gradient intermittent stream that at potential is dominated by Booth willow and tufted hairgrass. Other riparian species include smallwing sedge, creeping spike-rush and American vetch. Past alteration in Glade Canyon consisted of headcuts in its headwaters, lateral erosion and vertical incision in its middle section, and an absence of Booth willow along much of its length; however, Glade Canyon is improving except for the establishment of Booth willow in The Glade pasture of the Glade allotment.

High gradient streams. To the west, where the mesa top gives way to the Dolores River canyon, the swales become high gradient streams that are both entrenched and confined. These high gradient channels are predominantly ephemeral and are dominated by Ponderosa pine and dense Gambel oak. Aspen are occasionally present. Very little disturbance occurs along these sections of stream because of their steepness and inaccessibility and therefore most are functioning at their potential.

Headwater transition zones. At the transition zone between the mesa top and the confined channel, where the gradient initially begins to steepen, aspen and serviceberry are the dominant species with other species such as chokecherry, Rocky Mountain maple, mountain snowberry,

and Woods rose occurring in lesser amounts. These areas are accessible and susceptible to degradation. If altered, snowberry will dominate these areas and headcuts will form where flows begin to concentrate prior to entering the canyon.

Moderately steep, rocky canyons. Only a handful of streams draining to the west leave the mesa on a gentler gradient: Narraguinnep Canyon, Willow Draw, Salter Canyon, Dry Canyon, Plateau Creek, and Beaver Creek. Lower gradient sections of these streams can have well-developed riparian areas that consist of Narrowleaf cottonwood and coyote willow at potential. Alteration of these areas can include physical changes to the channel such as lateral erosion and/or vertical incision along with changes to the riparian vegetation such as limited or no regeneration of cottonwoods and willow, a decrease in riparian plant vigor, and/or an overall narrowing of the riparian area.

To the north, the swales on the mesa top steadily give way to moderately steep rocky canyons that at potential also support small galleries of narrowleaf cottonwood and coyote and/or yellow willow. Shrubs include red-osier (dogwood) and Saskatoon serviceberry. Herbaceous riparian species will include silvertop sedge, swamp bluegrass, blue wildrye, slender wheatgrass, and fringed brome. Similar to streams that drain the mesa to the west, alteration in these channels can include physical changes to the channel such as lateral erosion and/or vertical incision along with changes to the riparian vegetation such as limited or no regeneration of cottonwoods and willow, a decrease in riparian plant vigor, and/or an overall narrowing of the riparian area.

Low gradient, deeply incised channels. To the east and northeast, the Glade landscape is unique. Soils in this area are primarily derived from Mancos shale and are highly erosive. First order drainages in this area have been historically degraded and are predominantly gullies that do not support riparian vegetation. However, the gullies eventually give way to low gradient deeply incised stream channels, namely Ryman Creek and Hunt Creek, which can and do support plains or Rio Grande cottonwood intermixed with sandbar willow. The herbaceous understory is relatively sparse and is comprised of a variety of sedges along with some bulrush and common spikerush. Within the incised channel, the streams are building new floodplains that provide for energy dissipation, sediment deposition, and periodic flooding of vegetation. Alteration in these streams often involves mass wasting of steep vertical stream banks as the new channel finds it equilibrium. Large amounts of sediment entering the system will bury young cottonwoods and willow. Where they system is dry, the herbaceous understory may include cocklebur, yellow sweet clover, Kentucky bluegrass, and smooth brome.

Dolores River. And finally, to the West of the mesa top in a broad alluvial valley surround by steep canyon walls is the Dolores River. The Dolores River is a perennial stream partially controlled by flow releases from McPhee Reservoir. Narrowleaf cottonwoods, box elder, privet, thinleaf alder, and willow dominate its banks. Regulation of McPhee dam has resulted in year-round stream flow on this stretch of river that prior to the dam would go dry. This has limited cottonwood regeneration and increased the amount of willow. The active channel has effectively narrowed and the floodplain rarely becomes inundated with flood flows.

Lentic areas. Several springs are scattered throughout the Glade landscape. Most of them are developed. In the northern area, many of these are contact springs which occur where there is a

less permeable geologic layer found beneath a more permeable geologic layer. For example, Bankston Spring, Fader Spring, White Sands Spring, and Rock Spring all occur along the geologic contact between Dakota sandstone and the Dakota and Burro Canyon formation or the Morrison formation. The Dakota and Burro Canyon formation and Morrison formation are the less permeable geologic layers while the Dakota sandstone is the more permeable geologic layer. Water is discharged where these two layers meet. Because of the permeable nature of these formations, flow at these springs will vary with climatic conditions as will the expression of riparian vegetation. Riparian vegetation at these types of springs most often includes a variety of willow and herbaceous species. With wetter conditions, obligate wet species will dominate. With drier conditions, a range of facultative species will dominate. With exceptionally dry conditions, upland species will begin to establish. Livestock management that maintains the functional integrity of the spring will allow for the appropriate species to colonize based on current and recent climatic and hydrologic conditions.

There are also a number of concave parks (also called depressional wetlands) in the northern area of the landscape that at potential are dominated by woolly sedge, water sedge, and creeping spike-rush. Examples include Wild Bill Reservoir and Glade Point Reservoir. Most of these concave parks have been deepened to increase their water storage capacity: as a result, willows are present on the elevated earthen dams but are not generally a potential species at these sites. Elsewhere in the analysis area there are depression springs where water comes to the surface after flowing down gradient over an impervious geologic layer. Riparian vegetation at depression springs also includes a variety of willow and herbaceous species. Again, with wetter conditions, obligate wet species will dominate. With drier conditions, a range of facultative species will dominate. With exceptionally dry conditions, upland species will begin to establish. Alteration at springs and concave parks generally involves channelization of surface flows and/or inadequate vegetation on shorelines/soil surfaces and/or a reduction in the size of the riparian area along with changes to riparian-wetland plant composition.

Another riparian feature on the landscape is reservoirs. Reservoirs that tap into a spring or a high water table have the potential for abundant riparian vegetation. Such reservoirs at potential will have cattails growing in 2-4 feet of standing water and water sedge and beaked sedge along their shorelines. Examples of reservoirs with the potential for abundant riparian vegetation include Cabin and Ferris Reservoirs. If altered, the cattails will drop out of the system and the shoreline riparian vegetation will be replaced by drier site grasses and weedy forbs. A critical component of reservoir functioning is the condition of the dam and/or spillway. A breached dam or poorly functioning spillway will put the reservoir at risk.

Stream health and assessment of riparian conditions. Stream health is defined as the condition of a stream versus reference conditions for the stream type and geology (USDA Draft Technical Guidance Document for Determining Stream Health, 2006). Reference condition refers to a minimally impaired site with the least anthropogenic influences occurring within an ecoregion. There are three stream health class definitions: robust, at-risk, and diminished. Robust stream health class occurs when the stream exhibits high geomorphic, hydrologic, and/or biotic integrity relative to its natural potential condition (as represented by a suitable reference condition); at-risk stream health occurs when there is moderate integrity

relative to its natural potential condition; and, diminished stream health occurs when there is low integrity relative to its natural potential condition.

For the Glade landscape, Proper Functioning Condition was used to assess stream health (see *Appendix G Glade landscape: PFC assessments; Appendix H Glade landscape: Stream health condition*). It was also used to assess lentic areas (e.g., seeps, springs) and reservoirs. PFC was completed across the Glade landscape at various times. PFC was done previously on some riparian areas because other projects in the area required their assessment. In addition, field notes, site assessments, and photographs accompanied by notes taken by other staff (e.g., wildlife seasonals, hydrology seasonals) and other resource professionals (e.g., CSU's Colorado Natural Heritage Program) were used to make assessments. Of the remaining unassessed areas, a representative sample was chosen based on knowledge of the area and knowledge of where livestock are likely to graze. Thus, only a cross-section of the riparian resources present on the landscape was assessed. It is estimated that these assessments constitute approximately 75% of all possible lentic sites, 60% of all possible lotic sites, and 30% of the reservoirs.

Proper Functioning Condition is a qualitative survey used to assess the hydrology, vegetation and erosional/depositional processes of riparian areas (BLM TR 1737-15, 1998; BLM TR 1737-16, 1999, Revised 2003). Riparian areas are rated Proper Functioning Condition (PFC), Functional-At-Risk (FAR) or Non-Functional (NF). A rating of PFC means that all of the components (hydrology, vegetation, erosion/depositional features) are in place for the riparian area to function properly and there is nothing putting it at risk of degradation. In order to function properly, a riparian area needs adequate vegetation, landform, or large woody debris present to:

- dissipate energy associated with high water flows or wind action, wave action, and overland flows to reduce erosion and improve water quality;
- filter sediment, capture bedload (in running water riparian areas), and aid in floodplain development;
- improve flood water retention and ground water recharge;
- develop root masses that stabilize streambanks, islands, or shorelines against cutting action;
- restrict water percolation (in standing water riparian areas);
- develop diverse ponding and/or channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses;
- support greater biodiversity.

A FAR rating means that the riparian area is functioning but is at risk of degradation. Functional-At-Risk ratings typically include an assessment of trend. If the area shows evidence of improvement the associated trend will be upward. If the area shows evidence of deterioration the associated trend will be downward. In some cases, the trend is unknown or "not apparent." A rating of NF means that the riparian-wetland area is clearly not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus is not reducing erosion, improving water quality, etc.

For each PFC evaluation, the riparian-wetland area was rated against its capability. Capability is defined as the highest ecological status an area can attain given political, social, or economical restraints (often referred to as limiting factors). For each stream health evaluation, the stream was rated against its potential. Potential is defined as the highest ecological status a riparian-wetland area can attain given no political, social, or economical restraints (often referred to as PNC).

Using this approach, a rating of "proper functioning condition" was equivalent to robust stream health; a rating of "functional-at-risk" was equivalent to at-risk stream health; and a rating of "non-functional" was equivalent to diminished stream health. There are three exceptions where this direct correlation did not apply: Hunt Creek, Ryman Creek, and the Dolores River. Hunt Creek and Ryman Creek have both incised to such a degree that regardless of their current functional condition, they have low integrity when compared to their natural potential condition. And the Dolores River, because its flows are regulated by a dam, also has low integrity compared to its natural potential condition (which would be represented by a stream that was not influenced by a dam). In other words, for Hunt, Ryman, and the Dolores River their potential did not match their capability and so the ratings changed accordingly.

Causal factors have been identified for those riparian areas that did not rate PFC or FAR with an upward trend. Causal factors are those land uses or impacts that have a detrimental effect on the hydrology, vegetation, and/or erosion/deposition features of a riparian area. A variety of causal factors may exist: noxious weed invasion, roads that alter surface hydrology, flow regulation, historic livestock grazing, current livestock grazing, a failed or poorly designed development, recreational use, and wildlife use. Riparian areas that identify current livestock grazing as a causal factor will be addressed through changes in livestock management (see *Appendix I Glade landscape: Grazing as a causal factor*). For riparian areas that were not assessed, specific issues and causal factors are presently unknown; regardless, their desired condition is PFC. Should it become known that they are FAR with a downward trend or NF and the causal factor is current livestock grazing, changes in livestock management will be considered as it relates to those areas.

Table 3 Stream Health and Proper Functioning Condition ratings

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
Brumley	Black Snag	Black Snag Spring	FAR	Downward	Road disrupting hydrology, increase of Canada thistle at source	
		Cottonwood Draw	FAR	Not apparent	Current livestock grazing	At-risk
		Dawson Draw Canyon East	FAR	Not apparent	Current livestock grazing	At-risk

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
		Dawson Draw Canyon East (lower end)	PFC			Robust
		White Sands Spring	FAR	Not apparent/potentially downward	Poor development, wildlife use	
	Brumley	Brumley Reservoir	PFC			
	Far Draw	Far Draw	NF		Historic livestock grazing, current livestock grazing	Diminished
		Far Draw Spring	FAR	Not apparent/potentially downward	Current livestock grazing, wildlife use	
		Flat Reservoir	FAR	Not apparent/potentially downward	Historic livestock grazing, current livestock grazing	
		Near Draw	FAR	Not apparent/potentially upward	Historic livestock grazing	At-risk
	Near Draw	Near Draw #4 Spring	FAR	Downward	Current livestock grazing, wildlife use	
		Near Draw headwaters	NF		Current livestock grazing, historic livestock grazing	Diminished
		Narraguinnep Spring	FAR	Downward	Invasive weeds increasing throughout associated riparian area	
		Road Spring and	PFC			
	Plantation	Dry Lake	PFC			
		Evans Spring	PFC			

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
		Rock Spring	FAR	Downward	Current livestock grazing, wildlife use	
		Rock Spring B	FAR	Downward	Wildlife use	
	Ryman	Ryman Creek (north of Reservoir #4)	FAR	Upward		Diminished
		Ryman Creek (south of Reservoir #4)	NF		Historic livestock grazing	Diminished
	The Draw	Carroll Spring	PFC			
		Cole Spring	FAR	Downward	Current livestock grazing	
Calf	Dunham	Dunham Reservoir	PFC			
		Log Camp Spring (drainage below)	FAR	Downward	Current livestock grazing, close proximity to drainage from road	At-risk
		Calf Creek (unnamed tributaries)	FAR	Unknown	Signs of current livestock grazing impacts	At-risk
	Hinchman	Dry Canyon (headwaters)	FAR	Not apparent/potentially downward	Historic livestock grazing, current livestock grazing, wildlife, recreational use	At-risk
		Hinchman Reservoir	PFC			
		Calf Creek (unnamed tributaries)	FAR	Downward	Current livestock grazing	At-risk

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
	North Gathering, South Gathering, and Cow Camp Horse	Salter Canyon (unnamed headwater tributaries)	FAR	Downward	Current livestock grazing	At-risk
	Hoppe Point	Hoppe Spring	PFC			
		Hoppe Reservoir	FAR	Not apparent	Current livestock grazing	
	Salter Canyon	Salter Bench Reservoir	PFC			
		Salter Canyon	PFC			Robust
	Tozer	Knolls Reservoir	FAR	Downward	Current livestock grazing	
Glade	Beef Trail	Beef Trail Reservoir	FAR	Downward	Current livestock grazing	
		Diana Spring	PFC			
		Glade Mountain Spring	FAR	Downward	Current livestock grazing, wildlife use	
	Glade Lake Exclosure	Glade Lake	PFC			
	Glade Mountain	Bradfield Spring	FAR	Not apparent/potentially downward	Current livestock grazing	
		Bradfield #2 Spring	NF		Current livestock grazing	
		Manaugh Spring	FAR	Downward	Current livestock grazing	
	South Lake	Cow Spring	FAR	Not apparent	Current livestock grazing	
		Doe Spring	FAR	Not apparent/potentially downward	Current livestock grazing	
	Five Pines	Cow Canyon	FAR	Downward	Current livestock grazing, drainage from road	At-risk

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
	The Glade	Glade Canyon	FAR	Upward but with risk of headward erosion due to headcuts	Historic livestock grazing, nearby roads/old roads altering hydrology	At-risk
Lone Mesa	Hunt Creek	Hunt Creek	FAR	Upward		Diminished
	Thomas Mountain	Hunt Creek	PFC			Diminished
Long Park	Narraguinnep Unit	Narraguinnep Canyon (below Narraguinnep Reservoir to confluence with Dolores River)	PFC			Robust
		Narraguinnep Canyon (FS/private boundary to confluence above FS road 514)	FAR	Upward		At-risk
		Narraguinnep Canyon (confluence above FS Road 514 to just below Narraguinnep Reservoir)	FAR	Upward		At-risk
	Middle	Narraguinnep Canyon	PFC			Robust
	None	Narraguinnep Canyon	PFC			Robust
Mair	Big Water	Bankston Spring	PFC			
		Big Water Spring	PFC			
		Fader Spring	FAR	Downward	Current livestock grazing, wildlife use	
		Pine Arroyo Spring	FAR	Downward	Old road causing headcut	

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
	Glade	Garbareno Spring	FAR	Not apparent	Wildlife use	
		Glade Canyon (riparian above Glade	PFC			Robust
		Glade Canyon (most of Glade	FAR	Upward		At-risk
		Glade Canyon (horse pasture section)	PFC			Robust
		Glade Canyon	PFC			Robust
	Pole Canyon	Wild Horse Reservoir	PFC			
	Wild Bill	Chicken Aspen Reservoir	FAR	Not apparent	Current livestock grazing	
		Cornwallis Reservoir	PFC			
		Little Bill Reservoir	FAR	Not apparent	Current livestock grazing	
		Peeled Pine Spring	PFC			
		Wild Bill Reservoir #6	FAR	Not apparent	Current livestock grazing	
		Wild Bill Reservoir #9	FAR	Not apparent	Current livestock grazing	
	Wolf Den	Cottonwood Spring	FAR	Not apparent	Current livestock grazing	
		Pat Spring	PFC			
		Tom Wescott Spring	PFC			
		Wolf Den Reservoir	PFC			

Allotment	Pasture	Riparian Area	Rating	Trend	Causal Factors	Stream Health Rating
		Wolf Den Spring (and associated riparian area downstream)	FAR	Downward	Historic livestock grazing, unmaintained failed dams	
Sagehen	None	Plateau Creek	PFC			Robust
		Plateau Creek	PFC			Robust
		Beaver Creek	PFC			Robust
	Lone Dome	Dolores River	FAR	Not apparent	Flow regulation	Diminished
		Salter Canyon	PFC			Robust
Salter	Lower Salter Canyon	Willow Draw (headwaters)	FAR	Downward	Current livestock grazing	At-risk
	Salter Canyon	Cabin Reservoir	FAR	Downward	Current livestock grazing	
		Ferris Reservoir	PFC			
		Dry Lake Reservoir	PFC			
	Upper Salter Canyon	Salter Canyon (unnamed headwater tributaries)	FAR	Downward	Current livestock grazing	At-risk
	Willow Draw	Willow Draw	FAR	Not apparent/possibly downward	Current livestock grazing	At-risk

Desired conditions, standards, and guidelines. Desired conditions for riparian condition are derived from the WCP, the RMP, and local expert opinion. Most are represented qualitatively, some use metrics.

The WCP outlines the following management measures:

- Conduct actions so that stream pattern, geometry, and habitats maintain or improve long-term stream health (12.3 Management Measure 5).
- In the water influence zone (WIZ) next to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition (12.1 Management Measure 3). A design criterion of this

Management Measure is to "maintain the extent of stable banks in each stream reach at 74% or more of reference conditions."

- Maintain long-term ground cover, soil structure, water budgets, and flow patterns of wetlands to sustain the ecological function (12.4 Management Measure 6).

Within the RMP there are 20 desired conditions, 3 standards, and 7 guidelines that pertain to riparian-wetland areas that are potentially affected by livestock grazing. All of the desired conditions and standards and 5 of the 7 guidelines can be captured through an assessment of PFC. The specific desired conditions, standards, and guidelines and their relationship to PFC are captured in Table 5. The 2 guidelines that are metrics, and therefore not specifically captured by a PFC assessment, are stubble height based on season of use and woody species utilization. These are guidelines that are more appropriate for short-term effectiveness monitoring (see Monitoring section).

Table 4 Desired conditions cross-walked with PFC

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
Historically disturbed and degraded stream channels recover through floodplain development; establishment of riparian vegetation with correct structure, composition, and function; and stable channel geomorphic characteristics (DC 2.6.8). Riparian area and wetland ecosystems are resilient to change from disturbances (including from floods, fire, drought) and offer resistance and resiliance to changes in climate (DC 2.4.5).	Management actions must not cause long-term change away from desired conditions in riparian areas or wetlands. (S 2.4.21) Activities must not be allowed within aquatic management zones that will cause a long-term change from desired conditions. (S 2.6.30)	Grazing management activities should be modified in, or livestock excluded from, riparian areas that are "nonfunctional" or "functional-at risk" with a downward trend where livestock have been determined to be a key causative agent. (G 2.7.22) Agency actions should avoid or otherwise mitigate long-term adverse impacts to riparian areas and wetlands. (G 2.4.22) Trailing of livestock should be avoided along riparian areas to the extent practicable. (G 2.7.23)	APPLICABLE TO ALL ITEMS	APPLICABLE TO ALL ITEMS

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
Riparian area and wetland ecosystems have flow regimes and flooding processes that contribute to stream channel and floodplain development, maintenance, and function, and facilitate the regeneration of native hydrophytic plants that depend on flooding for regeneration of native hydrophytic plants that depend on flooding for regeneration. (DC 2.4.6) Stream channel types that naturally build floodplains are connected to their floodplains and riparian areas, maintain the ability to transport overbank flows, and are capable of transporting moderate or high flow events. (DC 2.6.6) Administrative and			Floodplain above bankfull is inundated in "relatively frequent" events	Riparian-wetland area is saturated at or near the surface or inundated in "relatively frequent" events

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
permitted activities on the SJNF do not contribute to the reduction of surface water or groundwater that supplies seasonal springs, seeps, small ponds, and small wetlands considered most vulnerable to a changing climate. (DC 2.6.11)				

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
Riparian area and wetland ecosystems have flow regimes and flooding processes that contribute to stream channel and floodplain development, maintenance, and function, and facilitate the regeneration of native hydrophytic plants that depend on flooding for regeneration of native hydrophytic plants that depend on flooding for regeneration. (DC 2.4.6) Administrative and permitted activities on the SJNF do not contributre to the reduction of surface water or groundwater that supplies seasonal springs, seeps, small ponds, and small wetlands considered most vulnerable to a changing climate. (DC				Fluctuation of water levels is not excessive

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
2.6.11)				
			Where beaver dams are present they are active and stable	
Channel features including bank stability, width-to-depth ratio, pool/riffle ratio, pool depth, slope, sinuosity, cover, and substrate composition are commensurate with those expected to occur under natural ranges of stream			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting	

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
flow. (DC 2.5.5) Streams have the most probable form and the expected native riparian vegetation composition within the valley landforms that they occupy. (DC 2.6.7)				
			Riparian-wetland area is widening or has achieved potential extent	Riparian-wetland area is widening or has achieved potential extent
Upland areas function properly and do not contribute to stream-channel degradation (DC 2.6.12)			Upland watershed is not contributing to riparian-wetland degradation	Upland watershed is not contributing to riparian-wetland degradation
State water quality standards and anti-degradation rules are met and state-classified water uses are supported for all water bodies. (DC 2.6.1)	Land use activities must not impact potentially useable groundwater quality or quantity to the extent that groundwater-			Water quality is sufficient to support riparian-wetland plants

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
	dependent features are adversely afffected. (S 2.6.29)			
				Natural surface or subsurface flow paterns are not altered by distrubance
The overall function and integrity of streams impacted by water developments are adequately protected for their baseline ecological and recreational values. (DC 2.6.13)				Structure accomodates safe passage of flows
Forest and shrubland types display hydrophytic trees and shrubs in a variety of size classes. (DC 2.4.3) Rangelands provide diverse, healthy, sustainable plant			There is diverse age-class distribution of riparian-wetland vegetation	There is diverse age-class distribution of riparian-wetland vegetation

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
communities and conserve soil quality (DC 2.7.5)				
Riparian area and wetland ecosystems have a diverse composition of desirable native hydrophytic plants that are vigorous and self-perpetuating. Invasive plant species are absent or rare. (DC 2.4.1) Streams have the most probable form and the expected native riparian vegetation composition within the valley landforms that they occupy. (DC 2.6.7) Rangelands provide diverse, healthy, sustainable plant communities and conserve soil quality (DC 2.7.5)		Agency actions should avoid or otherwise mitigate adverse impacts to the abundance and distribution of willows to maintain or improve the ecological integrity of riparian area and wetland ecosystems. (G 2.4.26) Woody riparian vegetation along low-gradient ephemeral and permanent stream channels should be maintained or restored to ensure terrestrial food sources for invertebrates, fish, birds, and mammals,	There is diverse composition of riparian-wetland vegetation	There is diverse composition of riparian-wetland vegetation

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
		and to minimize water temperature changes. (G 2.4.28)		
Long-term levels of soil organic matter and soil nutrietns are maintained at acceptable levels on all riparian area and wetland ecosystems. (DC 2.4.10) Habitat components are maintained. Unique habitat types (e.g., springs, seeps, willow carrs, caves, and cliffs) support associated flora and fauna (with abundance and distribution commensurate with the			Species present indicate maintenance of riparian-wetland soil moisture characteristics	Species present indicate maintenance of riparian-wetland soil moisture characteristics

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
capability of the land). (DC 2.3.4)				
Riparian area and wetland ecosystems have a diverse composition of desirable native hydrophytic plants that are vigorous and self-perpetuating. Invasive plant species are absent or rare. (DC 2.4.1)			Steambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events	Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows
Riparian area and wetland ecosystems have a diverse composition of desirable native hydrophytic plants that are vigorous and self-perpetuating. Invasive plant species are absent or		Livestock browsing should not remove more than 25% of the annual leader growth of hydrophytic shrubs and trees. (G 2.4.25)	Riparian-wetland plants exhibit high vigor	Riparian-wetland plants exhibit high vigor

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
rare. (DC 2.4.1)				
Vegetation cover is sufficient to catch sediment, dissipate energy, prevent erosion, stabilize stream banks, enhance aquatic and terrestrial wildlife habitat, and promote floodplain development. (DC 2.4.2) Ground cover (vegetation and litter) is adequate to protect soils and prevent erosion on all riparian area and wetland ecosystems of the SJNF and TRFO. (DC 2.4.11)		The residual riparian vegetation guideline, as shown in Table 2.7.2, should be met or exceed at the time the livestock leave the pasture/allotment. (S 2.7.28)	Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows	Adequate riparian-wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
				Frost or abnormal hydrologic heaving is not present

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
Forest and shrubland types display hydrophytic trees…provide woody channel debris... (DC 2.4.3) Woody debris in a variety of sizes is present in forest and shrubland riparian area and wetland ecosystem types. (DC 2.4.4)			Plant communities are an adequate source of coarse and/or large woody material	
				Favorable microsite condition is maintained by adjacent site characteristics
State water quality standards and anti-degradation rules are met and state-classified water uses are supported for all water bodies. (DC 2.6.1)	Land use activities must not impact potentially useable groundwater quality or quantity to the extent that groundwater-dependent features are adversely afffected. (S 2.6.29)			Accumulation of chemicals affecting plant productivity/composition is not apparent

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
Long-term levels of soil organic matter and soil nutrients are maintained at acceptable level on all riparian area and wetland ecosystems of the SJNF. (DC 2.4.10)				Saturation of soils is sufficient to compose and maintain hydric soils
				Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
Vegetation cover is sufficient to catch sediment, dissipate energy, prevent erosion, stabilize stream banks, enhance aquatic and terrestrial wildlife habitat, and promote floodplain development. (DC 2.4.2)			Floodplain and channel characteristics are adequate to dissipate energy	
			Point bars are revegetating with	

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
			riparian-wetland vegetation	
Channel features including bank stability, width-to-depth ratio, pool/riffle ratio, pool depth, slope, sinuosity, cover, and substrate composition are commensurate with those expected to occur under natural ranges of stream flow. (DC 2.5.5)			Lateral stream movement is associated with natural sinuosity	
Channel features including bank stability, width-to-depth ratio, pool/riffle ratio, pool depth, slope, sinuosity, cover, and substrate composition are commensurate with those expected to occur under natural ranges of stream flow. (DC 2.5.5)			System is vertically stable	

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
Riparian area and wetland ecosystems are resilient to change from disturbances (including fire, floods, and drought) and offer resistance and resilience to changes in climate. (DC 2.4.5) Physical channel characteristics are in dynamic equilibrium and commnesurate with the natural ranges of dishcharge and sediment load provided to a stream. (DC 2.6.7) Upland areas function properly and do not contribute to stream-channel degradation (DC 2.6.12).			Stream is in balance with the water and sediment being supplied by the watershed	Riparian-wetland is in balance with the water and sediment being supplied by the watershed
Vegetation cover is sufficient to catch sediment, dissipate energy, prevent erosion, stabilize stream banks, enhance				Islands and shoreline characteristics are adequate to dissipate wind and wave event energies

Desired Conditions	Standards	Guidelines	Standard Checklist PFC Items	Lentic Standard Checklist PFC
aquatic and terrestrial wildlife habitat, and promote floodplain development. (DC 2.4.2)				

Desired conditions specific to the stream types found in the Glade landscape as derived from expert opinion are found in Tables 5-11.

Table 5 Desired conditions for low gradient swales/slope wetlands

DFC	Moving towards	Moving away
• Saturated at or near the surface in relatively frequent events • Riparian-wetland area widening or at potential extent • Diverse composition of riparian vegetation that includes water sedge, beaked sedge, common spikerush; minimal amount of forbs • Continuous mat of riparian species providing adequate cover to protect soil surface • System is vertically stable or if system was vertically unstable before, the riparian width is likely to be limited by the width of the incised channel; however, it is no longer downcutting, vegetation is stabilizing the bed and banks, previously bare areas are covered with a continuous mat of riparian species, and headcuts are no longer actively eroding	• Saturation at or near the surface occurs for longer periods of time • Riparian-wetland area widening • Diversity of riparian species is increasing • Amount of riparian species is increasing/cover is increasing • If previously vertically unstable, system has stopped downcutting and now has vegetation stabilizing the bed and slopes	• Diversity of riparian species decreasing; species such as shrubby cinquefoil, wild iris, dandelion, and Kentucky bluegrass is increasing • Riparian-wetland area is decreasing through drying/loss of riparian species or downcutting • Riparian species sparse; bare ground is increasing • System is vertically unstable/downcutting is occurring/headcuts are actively eroding

Table 6 Desired conditions for Glade Canyon

DFC	Moving towards	Moving away
• Saturated at or near the surface in relatively frequent events • Riparian-wetland area widening or at potential extent • Diverse composition of riparian vegetation that includes predominantly Booth willow, tufted hairgrass, smallwing sedge, creeping spike-rush, and American vetch; minimal amount of forbs • Diverse age-class of willow with young age-classes present • Riparian species exhibit high vigor • Continuous mat of riparian species providing adequate cover to protect soil surface • System is laterally and vertically stable or if system was vertically unstable before, the riparian width is likely to be limited by the width of the incised channel; however, it is no longer downcutting, vegetation is stabilizing the bed and banks, previously bare areas are covered with a continuous mat of riparian species, and headcuts are no longer actively eroding	• Saturation at or near the surface occurs for longer periods of time • Riparian wetland area widening • Diversity of riparian species is increasing which includes Booth willow, tufted hairgrass, smallwing sedge, creeping spike-rush, and American vetch, among others • Amount of riparian species is increasing/cover is increasing • Willow, in particular, is establishing/increasing • Vertically unstable areas have stopped downcutting and now have vegetation stabilizing the bed and slopes • Laterally unstable areas have stopped eroding the banks; banks are stabilized with vegetation	• Saturation at or near the surface occurs for less amount of time/area is drying out • Riparian wetland area is decreasing through drying/loss of riparian species or downcutting • Diversity of riparian species is decreasing; species such as Kentucky bluegrass, dandelion, and yellow sweet clover are increasing • Willow species are being heavily browsed; no young age-class willows present • Riparian species sparse; bare ground is increasing • System is vertically unstable/downcutting is occurring/headcuts are actively eroding • System is laterally unstable/bank erosion is occurring

Table 7 Desired conditions for headwater transition zones

DFC	Moving towards	Moving away
• Saturated at or near the surface in relatively frequent events • Riparian-wetland area widening or at potential extent • Diverse composition of riparian vegetation that includes aspen and serviceberry and lesser amounts of chokecherry, Rocky Mountain maple, mountain snowberry, and Woods rose • Diverse age-class of aspen • Riparian species exhibit high vigor • Continuous mat of riparian species providing adequate cover to protect soil surface • System is laterally and vertically stable or if system was vertically unstable before, the riparian width is likely to be limited by the width of the incised channel; however, it is no longer downcutting, vegetation is stabilizing the bed and banks, previously bare areas are covered with a continuous mat of riparian species, and headcuts are no longer actively eroding	• Saturation at or near the surface occurs for longer periods of time • Riparian wetland area widening • Diversity of riparian species is increasing which includes aspen and serviceberry and lesser amounts of chokecherry, Rocky Mountain maple, mountain snowberry, and Woods rose • Amount of riparian species is increasing/cover is increasing • Vertically unstable areas have stopped downcutting and now have vegetation stabilizing the bed and slopes/headcuts are no longer actively eroding	• Saturation at or near the surface occurs for less amount of time/area is drying out • Riparian wetland area is decreasing through drying/loss of riparian species or downcutting • Diversity of riparian species is decreasing; aspen are not regenerating • Riparian species sparse; bare ground is increasing • Young aspen are heavily browsed or there is only older age-classes of aspen present • System is vertically unstable/downcutting is occurring/headcuts are actively eroding

Table 8 Desired conditions for moderately steep rocky canyons

DFC	Moving towards	Moving away
• Floodplain above bankfull inundated in relatively frequent events • Riparian-wetland area widening or at potential extent • Diverse composition of riparian vegetation that includes narrowleaf cottonwood, coyote and/or yellow willow, red-osier (dogwood), Saskatoon serviceberry, silvertop sedge, swamp bluegrass, blue wildrye, slender wheatgrass, and fringed brome • Diverse age-class of cottonwood and willow with young age-classes present • Riparian species exhibit high vigor • Continuous mat of riparian species providing adequate cover to protect soil surface • System is laterally and vertically stable (stream channel is connected to its floodplain) or if system was vertically unstable before, the riparian width is likely to be limited by the width of the incised channel; however, it is no longer downcutting, vegetation is stabilizing the bed and banks, previously bare areas are covered with a continuous mat of riparian species, and headcuts are no longer actively eroding	• Floodplain inundated in places where it is connected • Riparian wetland area widening • Diversity of riparian species is increasing which includes narrowleaf cottonwood, coyote and/or yellow willow, red-osier (dogwood), Saskatoon serviceberry, silvertop sedge, swamp bluegrass, blue wildrye, slender wheatgrass, and fringed brome • Young age-classes of cottonwood and willow are present/increasing • Amount of riparian species is increasing/cover is increasing • Vertically unstable areas have stopped downcutting and now have vegetation stabilizing the bed and slopes/headcuts are no longer active • Laterally unstable areas have stopped eroding the banks; banks are stabilized with vegetation	• Floodplain no longer inundated • Riparian wetland area is decreasing through drying/loss of riparian species or downcutting • Diversity of riparian species is decreasing; condition of palatable shrubs (willows, red-osier, serviceberry) will be poor; shrubby cinquefoil, Kentucky bluegrass, and Ponderosa pine will increase/invade • Willow species are being heavily browsed; no young age-class willows present • Cottonwood not regenerating • Riparian species sparse; bare ground is increasing • System is vertically unstable/downcutting is occurring/headcuts are actively eroding • System is laterally unstable/bank erosion is occurring

Table 9 Desired conditions for low gradient, deeply incised channels

DFC	Moving towards	Moving away (or towards a new equilibrium)
• Floodplain above bankfull inundated in relatively frequent events • Riparian-wetland area widening or at potential extent • Diverse composition of riparian vegetation that includes plains or Rio Grande cottonwood, sandbar and other types of willow, a variety of sedges, some bulrush and common spikerush • Diverse age-class of cottonwood and willow with young age-classes present • Riparian species exhibit high vigor • Continuous mat of riparian species providing adequate cover to protect soil surface • System is laterally stable • Because the system was vertically unstable and has downcut 10's of feet, the riparian width is likely to be limited by the width of the incised channel; however, it is no longer downcutting, vegetation is stabilizing the bed and banks, previously bare areas are covered with a continuous mat of riparian species, and headcuts are no longer actively eroding	• Floodplain inundated in places where it is connected • Floodplain capturing sediment and building banks • Riparian wetland area widening • Diversity of riparian species is increasing which includes narrowleaf cottonwood, coyote and/or yellow willow, red-osier (dogwood), Saskatoon serviceberry, silvertop sedge, swamp bluegrass, blue wildrye, slender wheatgrass, and fringed brome • Young age-classes of cottonwood and willow are present/increasing • Amount of riparian species is increasing/cover is increasing • Vertically unstable areas have stopped downcutting and now have vegetation stabilizing the bed and slopes/headcuts are no longer active • Laterally unstable areas have stopped eroding the banks; banks are stabilized with vegetation	• Floodplain no longer inundated • Sediment is not being captured; banks eroding/washing out • Riparian wetland area is decreasing through drying/loss of riparian species or downcutting • Diversity of riparian species is decreasing; cocklebur, yellow sweet clover, Kentucky bluegrass, and smooth brome invading • Willow species are being inundated with sediment • Cottonwood not regenerating or unable to establish • Riparian species sparse; bare ground is increasing • System is vertically unstable/downcutting is occurring/headcuts are actively eroding • System is laterally unstable/bank erosion is occurring

Table 10 Desired conditions for the Dolores River

DFC	Moving towards	Moving away
• Floodplain above bankfull occassionally and partially inundated • Riparian-wetland area at potential extent • Diverse composition of riparian vegetation that includes narrowleaf cottonwood, box elder, privet, thinleaf alder, and a variety of willow • Diverse age-class of cottonwood and willow with young age-classes present • Riparian species exhibit high vigor • Continuous mat of riparian species providing adequate cover to protect soil surface • System is laterally and vertically stable (stream channel is connected to its floodplain) • Riffle habitat is occasionally flushed of sediment Pools are occasionally flushed of sediment	• Diversity of riparian species is increasing which includes narrowleaf cottonwood, box elder, privet, thinleaf alder, and a variety of willow • Young age-classes of cottonwood and willow are present/increasing • Amount of riparian species is increasing/cover is increasing • Riffle habitat is being maintained by flushing flows • Pools are being flushed of sediment	• Riparian wetland area is decreasing through drying/loss of riparian species • Diversity of riparian species is decreasing • Willow dominates stream banks and is growing further into active channel • Cottonwood not regenerating or unable to establish • Riparian species sparse; bare ground is increasing • Stream channel becomes entrenched or further entrenched • Pool habitat dominates and pools fill with sediment such that the stream channel gradient approaches zero

Table 11 Desired conditions for lentic areas

DFC	Moving towards	Moving away
• Saturated at or near the surface in relatively frequent events • Riparian-wetland area widening or at potential extent • Natural surface or subsurface flow patterns not altered by disturbance • If a reservoir, the structure accommodates safe passage of flows • Diverse age-classes of riparian wetland vegetation • Diverse composition of riparian wetland vegetation (species composition may change based on current and recent climatic and hydrologic conditions) • Continuous mat of riparian species providing adequate cover to protect shoreline/soil surface	• Saturation at or near the surface occurs for longer periods of time • Riparian-wetland area widening • Altered flow patterns are returning to their previous undisturbed conditions • Diversity of age-classes in increasing • Diversity of riparian species is increasing • Amount of riparian species is increasing/cover is increasing	• Saturation at or near the surface occurs for less amount of time • Riparian-wetland area shrinking • Flow patterns are altered by disturbance and connecting to effective concentrate flow • If a reservoir, the structure is failing • Diversity of age-classes decreasing • Diversity of riparian species decreasing • Amount of riparian species is decreasing/cover is decreasing

Monitoring. If there are riparian issues within a pasture, then one or more of those riparian areas were recommended for monitoring (see *Appendix J Glade landscape: Recommended monitoring locations*). The following parameters, in addition to a reassessment of PFC within 10 years, are suggested for monitoring:

Table 12 Recommended monitoring parameters for specific riparian locations (metrics)

Allotment	Pasture	Monitoring locations	Recommended stubble heights*	Recommended woody species utilization (if applicable)	Recommended Bank Stability
Brumley	Black Snag	Cottonwood Draw	4/5/6	<25%	>74%
Brumley	Far Draw	Far Draw	5/6/8	<25%	>74%
Brumley	Far Draw	Far Draw Spring	4/5/6	<25%	
Brumley	Far Draw	Near Draw	4/5/6	<25%	>74%
Brumley	Near Draw	Near Draw Spring #4	5/6/8	<25%	
Brumley	Near Draw	Near Draw headwaters	5/6/8	<25%	>74%
Brumley	Plantation	Rock Spring	5/6/8	<25%	
Brumley	Plantation	Rock Spring B	5/6/8	<25%	

Allotment	Pasture	Monitoring locations	Recommended stubble heights*	Recommended woody species utilization (if applicable)	Recommended Bank Stability
Calf	Dunham	Drainage below Log Camp Spring	5/6/8	<25%	>74%
Calf	Hinchman	Dry Canyon headwaters	4/5/6	<25%	>74%
Calf	North Gathering, South Gathering, and Cow Camp Horse	Salter Canyon (unnamed headwater tributaries)	5/6/8	<25%	>74%
Glade	Beef Trail	Beef Trail Reservoir	5/6/8	<25%	
Glade	Beef Trail	Glade Mountain Spring	5/6/8	<25%	
Glade	Glade Mountain	Bradfield Spring	5/6/8	<25%	
Glade		Bradfield Spring #2	5/6/8	<25%	
Glade	Five Pines	Cow Canyon	5/6/8	<25%	>74%
Glade	The Glade (and Glade of the Mair allotment)	Glade Canyon	5/6/8	<25%	>74%
Long Park	Narraguinnep Unit	Narraguinnep Canyon (FS/private boundary to confluence above FS road 514)	5/6/8	<25%	>74%
Mair	Big Water	Pine Arroyo Spring	5/6/8	<25%	
Salter	Lower Salter Canyon	Willow Draw (headwaters)	5/6/8	<25%	>74%
Salter	Salter Canyon	Cabin Reservoir	5/6/8	<25%	
Salter	Willow Draw	Willow Draw	5/6/8	<25%	>74%

*Stubble height is specified according to early/mid/late season use. Early season is from on date to the end of June. Mid-season is July and August. Late season is September and October.

Plant communities with conservation status. In the LRMP, riparian guideline 2.4.23 states, "Agency actions should avoid or otherwise mitigate long-term adverse impacts in riparian area and wetland ecosystems that have plant communitities with G1, G2, S1, or S2 NatureServe Plant Community conservation status ranks, including wild privet shrublands and boxelder/river birch woodlands, in order to maintain the ecological integrity of those rare plant communities." The Colorado Natural Heritage Program assessed several riparian and wetland areas across the Glade landscape for the conservation status of their natural vegetation communities. Areas identified by CNHP are not the only natural communities present on the landscape; they are just the ones that were assessed.

Conservation status assessments attempt to determine which species and ecosystems are thriving and which are rare or declining (www.natureserve.org). The conservation status of a natural community is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global, N = National, and S = Subnational). If an area is given a 2, it is imperiled. If an area is given a 1, it is critically imperiled. Within the Glade landscape there are eight potential conservation areas that support natural communities that rank either G2 or S2 or both (see *Appendix K Glade landscape: Conservation locations*). The natural communities are Narrowleaf cottonwood riparian forests, montane willow carrs, foothills riparian shrubland, herbaceous vegetation (awned sedge wet meadow), and Strapleaf willow-Coyote willow. Again, the areas identified in the Glade landscape are not the only places in which the natural communities exist and as with all riparian-wetland areas, the goal for livestock management will be to maintain the functional integrity of the riparian area/natural community.

Table 13 Conservation status of natural communities on Glade landscape

General Location Description	Natural Community	Conservation Status (Global and State)
Glade Canyon Spring/lower end of Glade Creek	Montane willow carr	G2, S2
Cottonwood Draw	Narrowleaf cottonwood riparian forests, foothills riparian shrubland	G2, S2
lower Dolores River between dam and Bradfield	Strapleaf willow-Coyote willow	G2, S2
Dolores River at Ferris Canyon	Narrowleaf cottonwood riparian forests	G2, S2
Dawson Draw Canyon East	Narrowleaf cottonwood riparian forests	G2, S2
upper Plateau Creek	Montane willow carr	S2
Glade Lake	Herbaceous vegetation (awned sedge wet meadow)	S2

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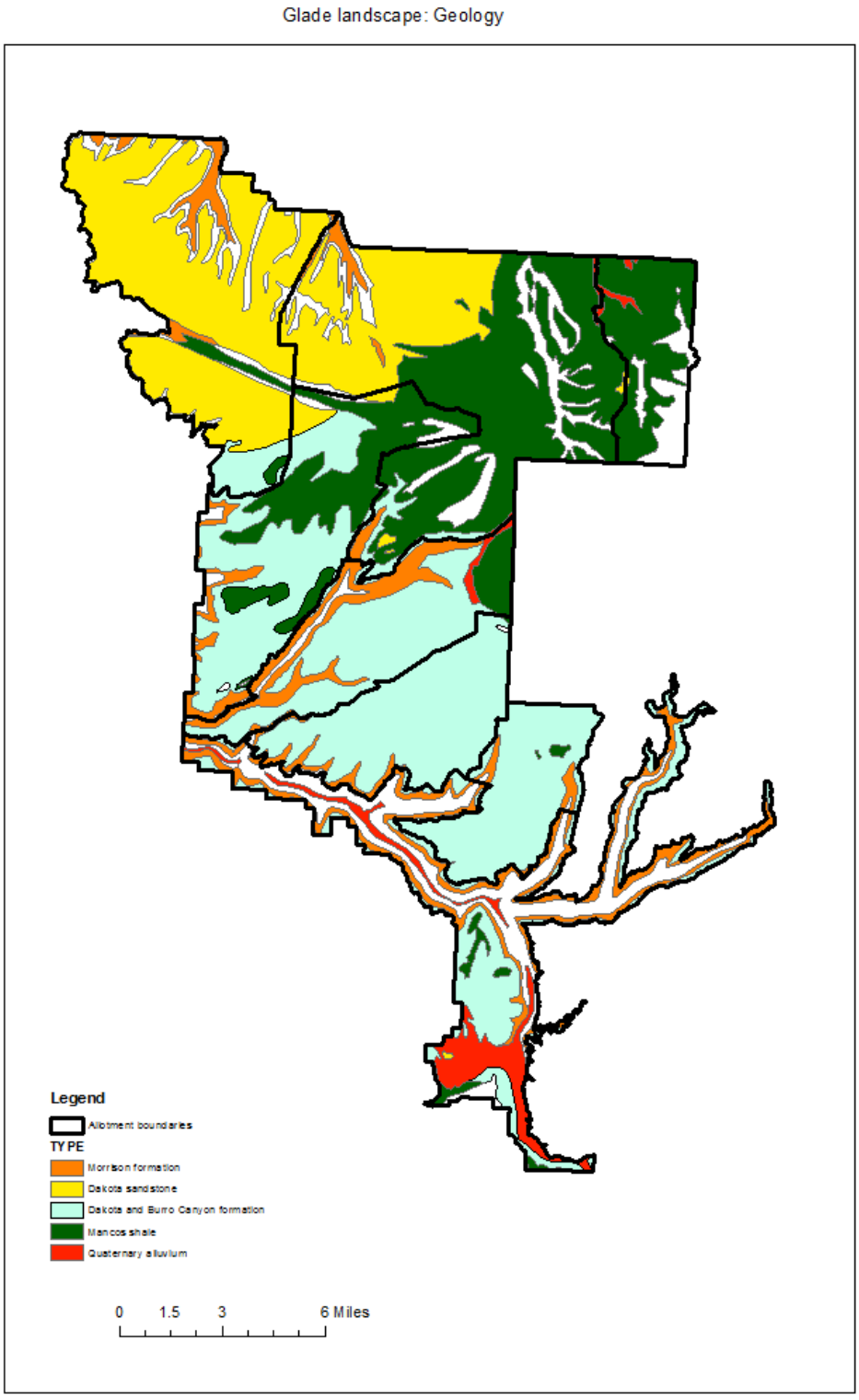
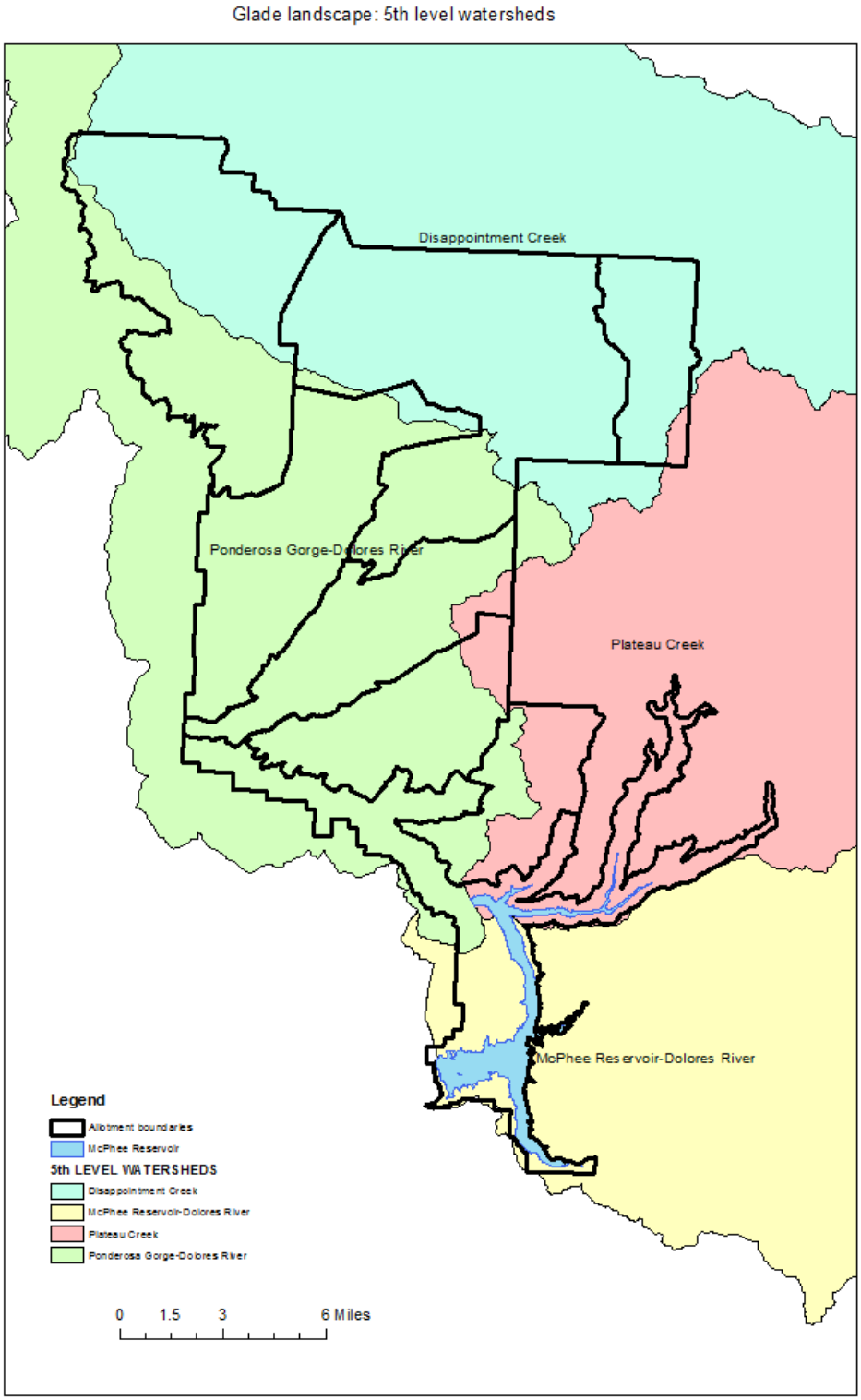
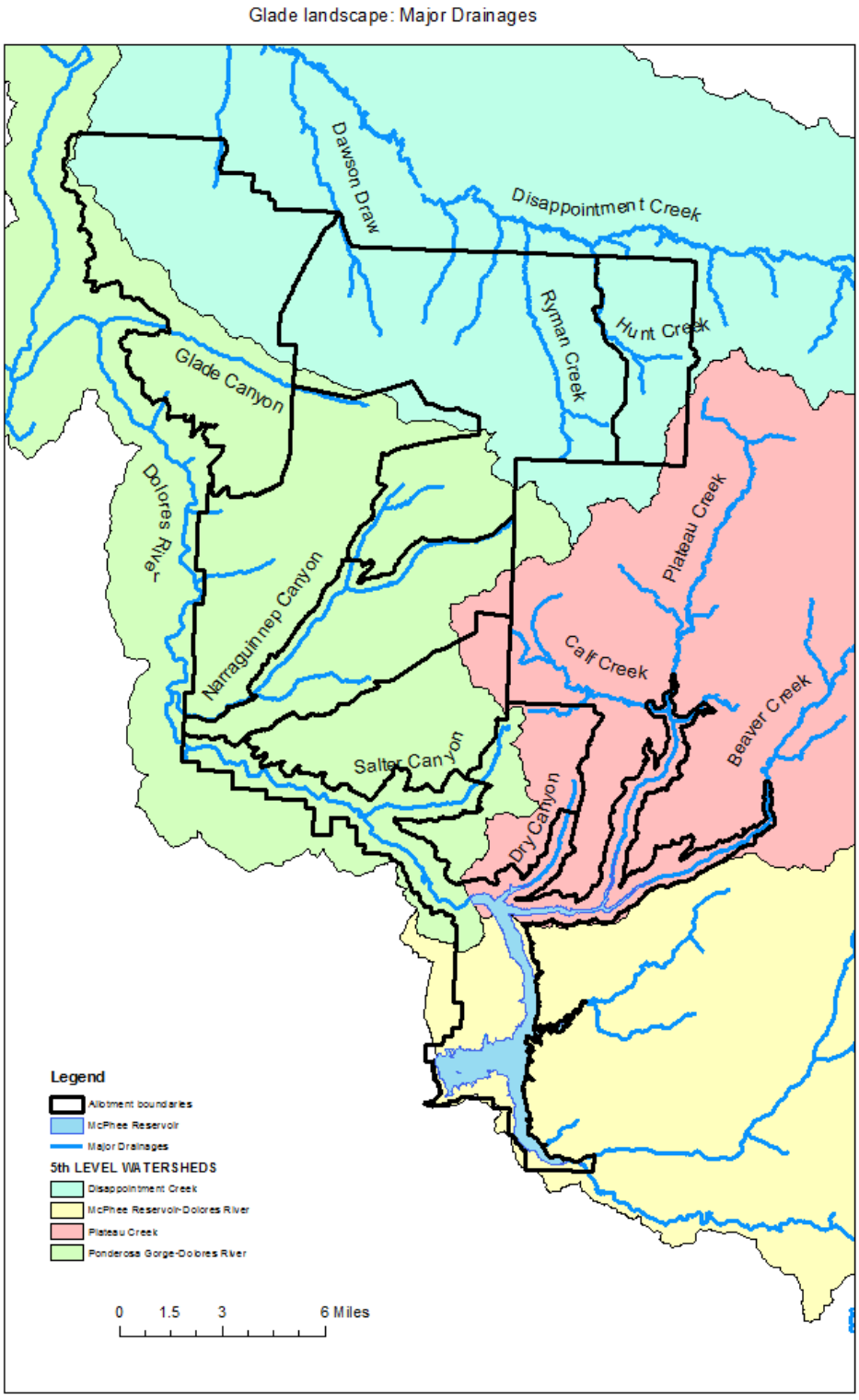
Appendix A Glade landscape: Geology



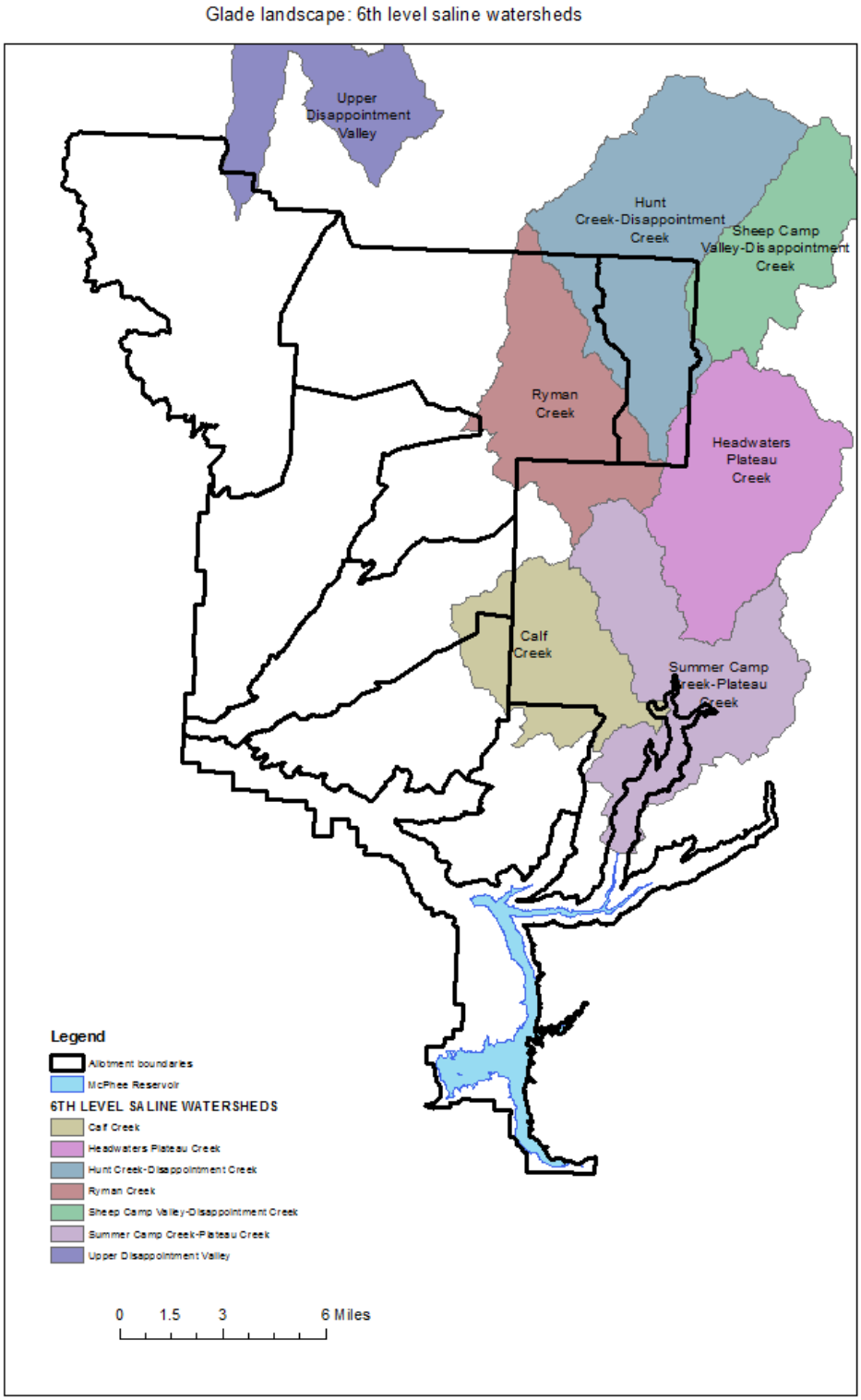
Appendix B Glade landscape: 5th level watersheds



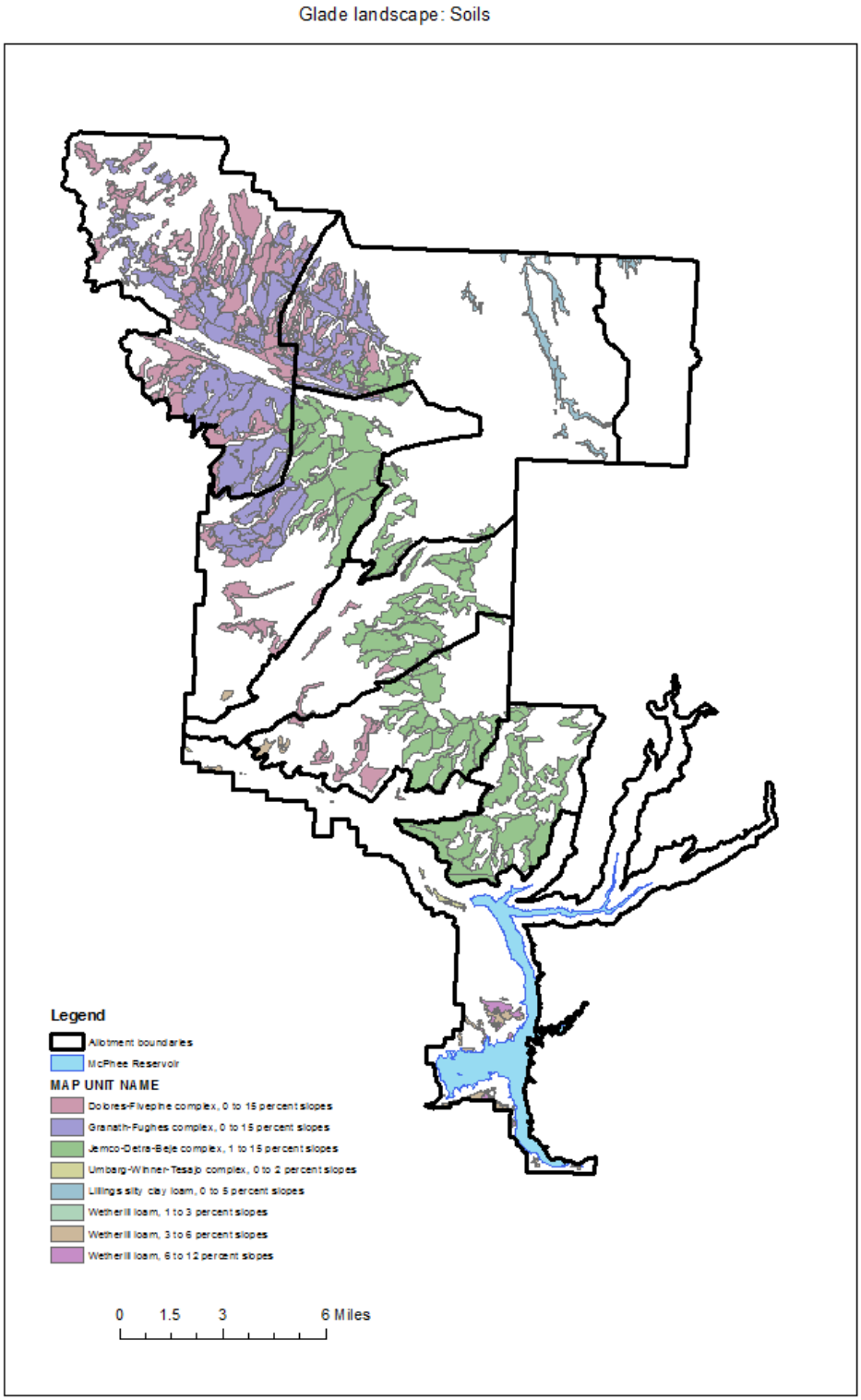
Appendix C Glade landscape: Major drainages



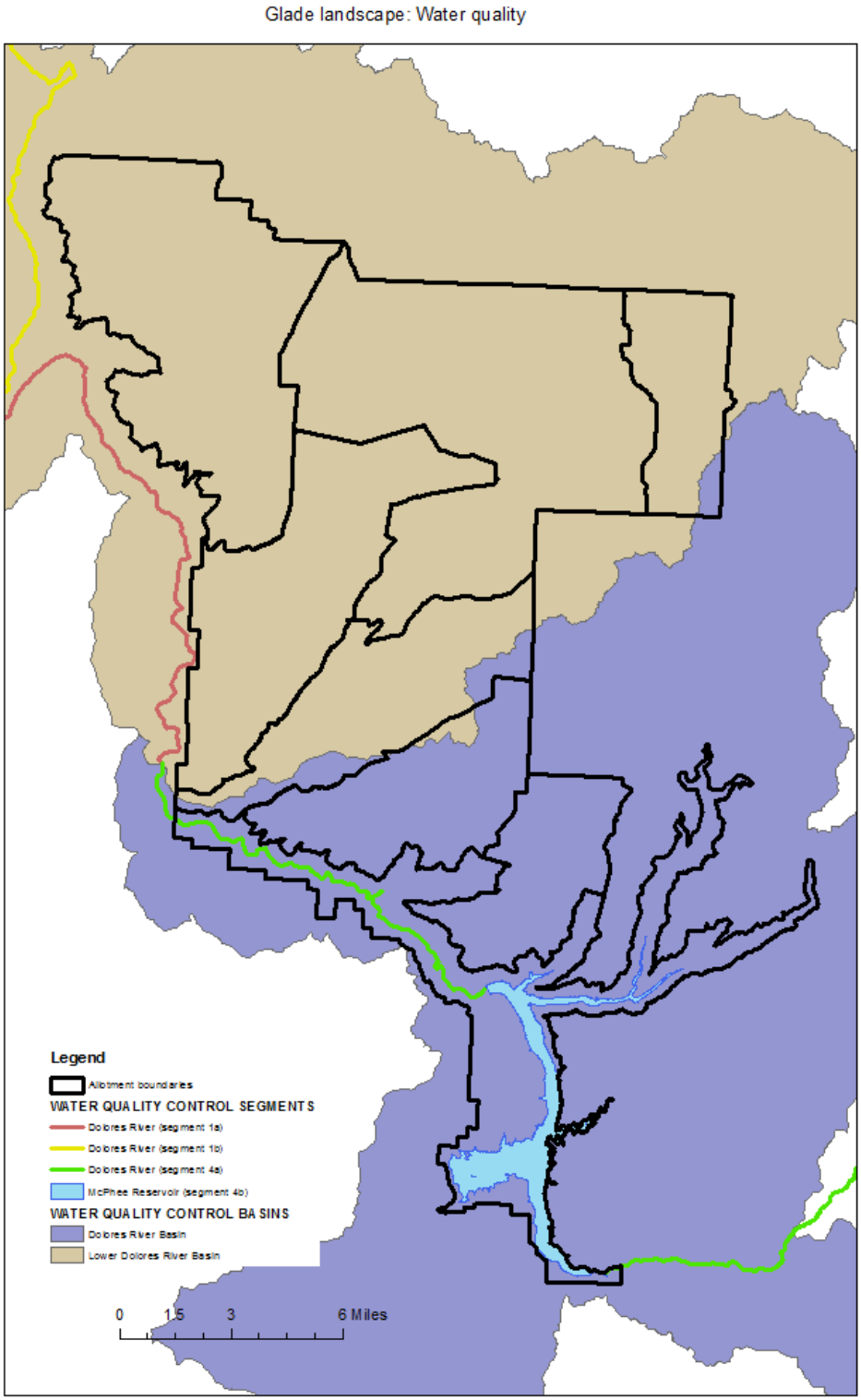
Appendix D Glade landscape: 6th level saline watersheds



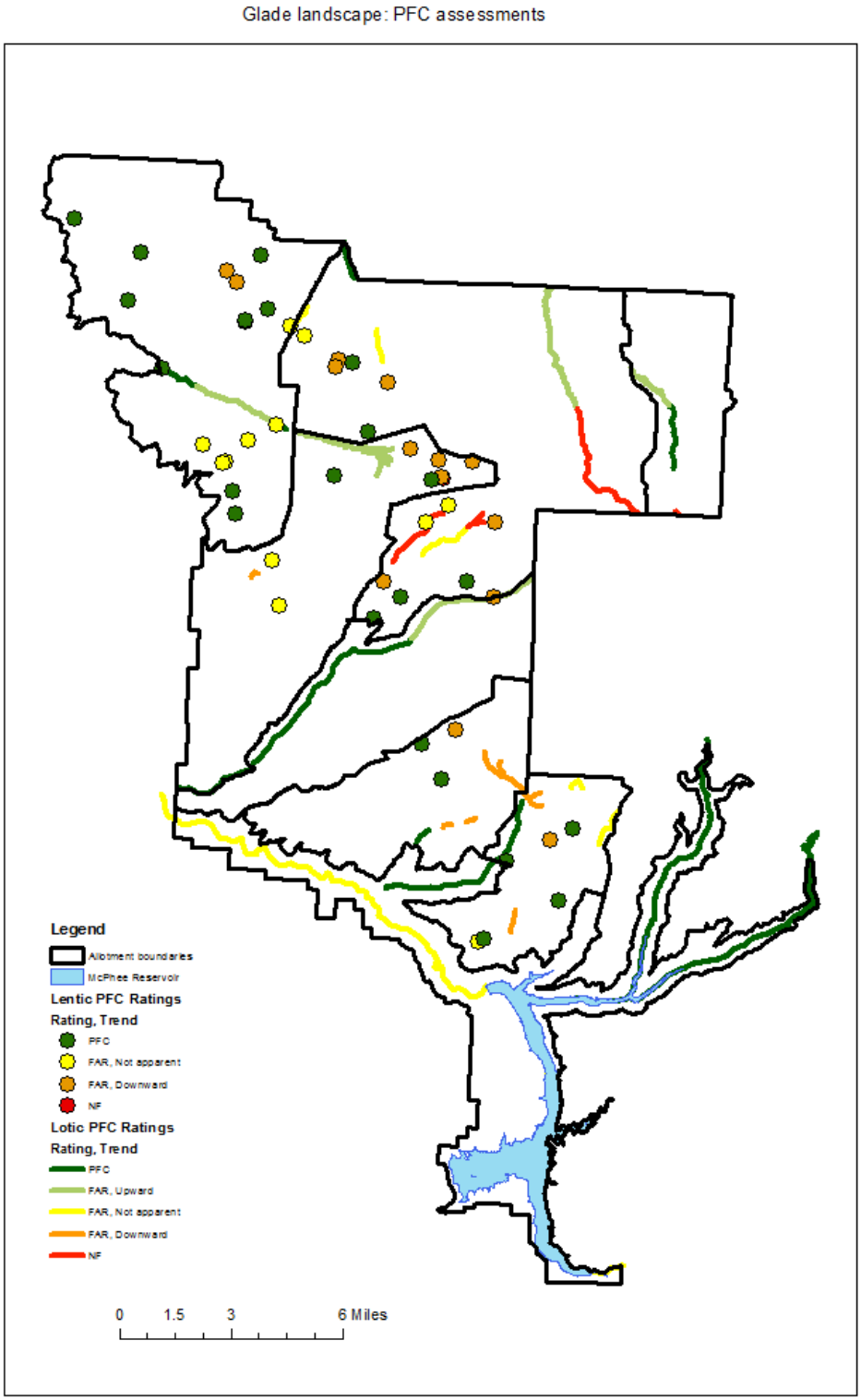
Appendix E Glade landscape: Soils



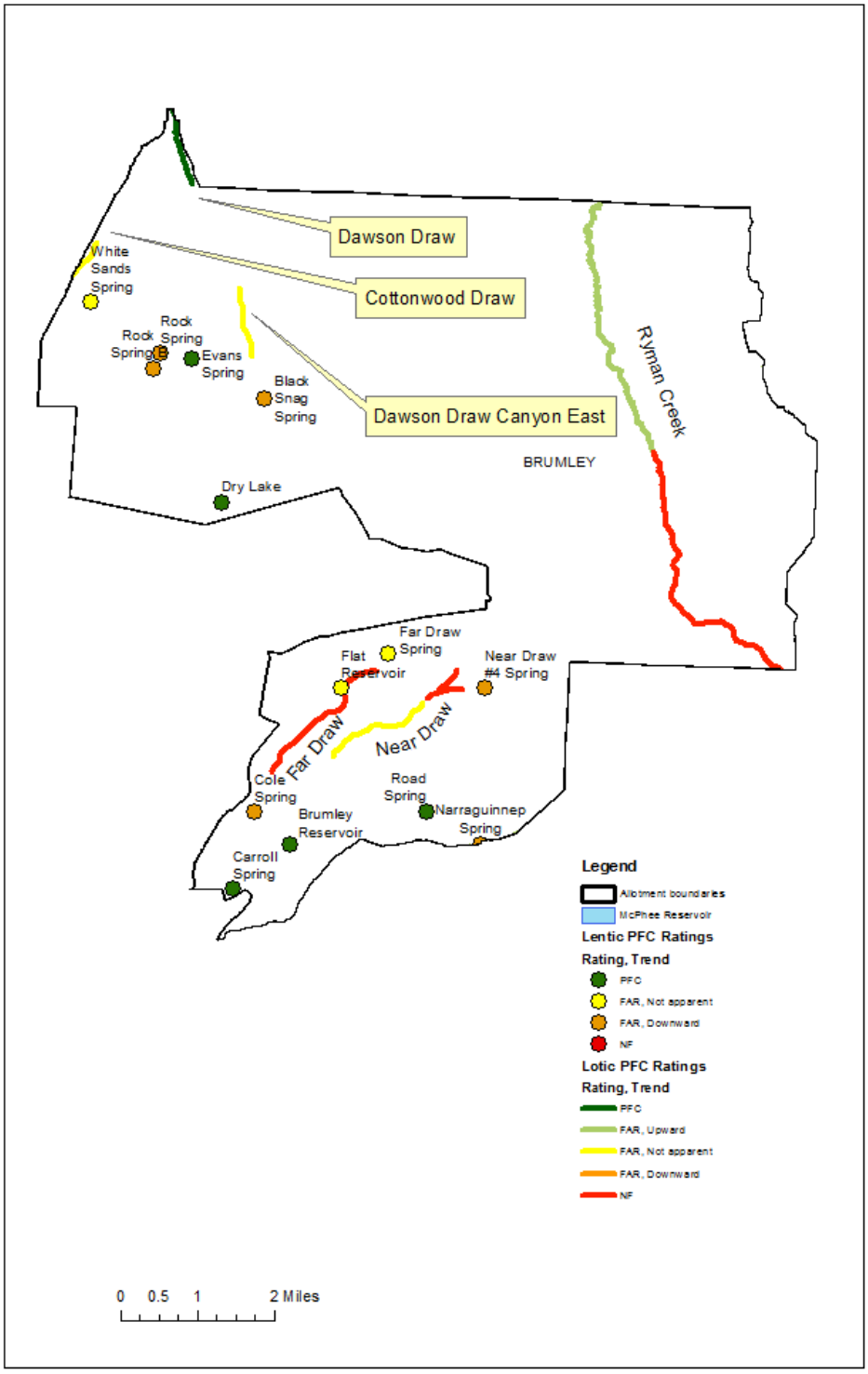
Appendix F Glade landscape: Water quality



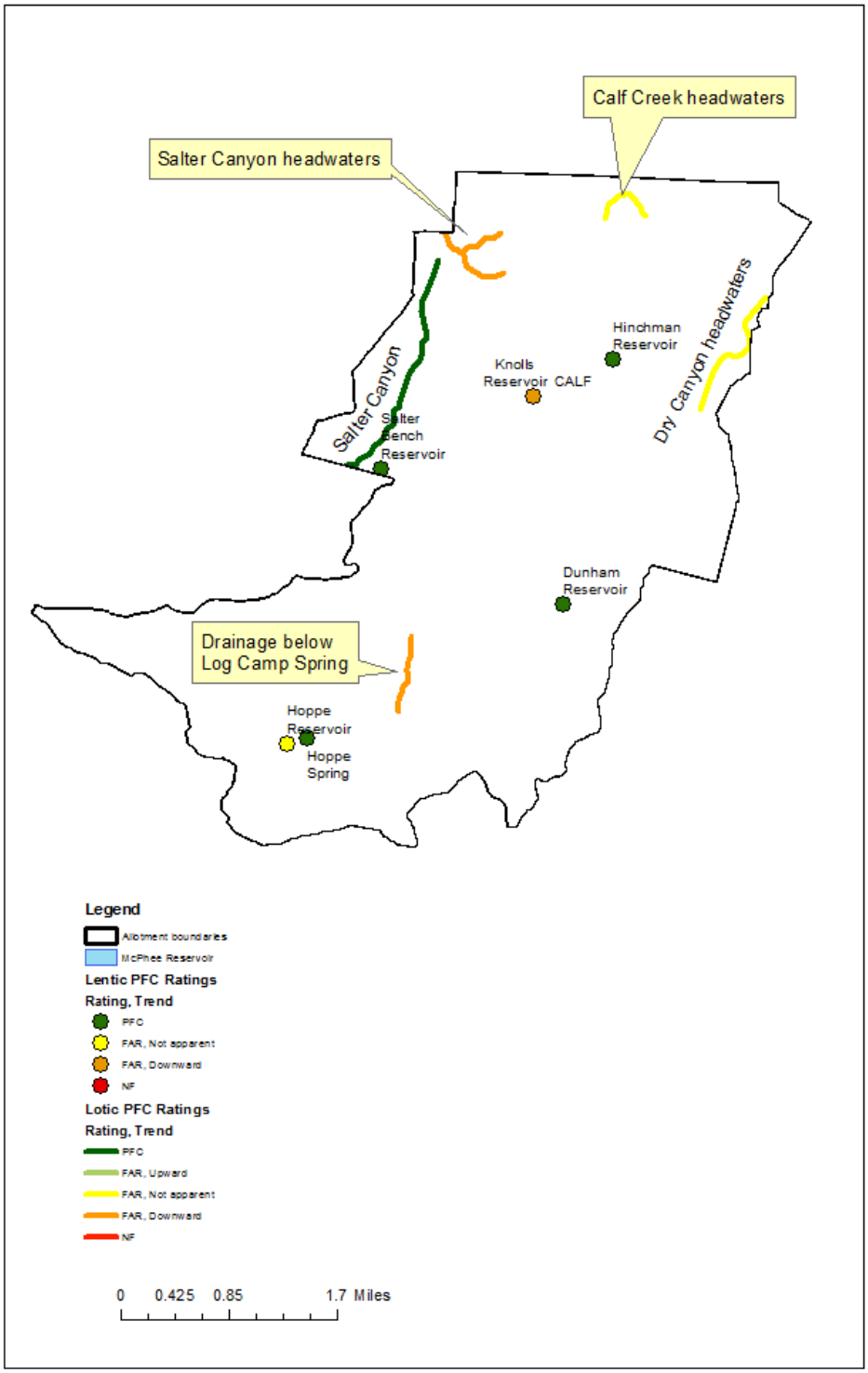
Appendix G Glade landscape: PFC assessments



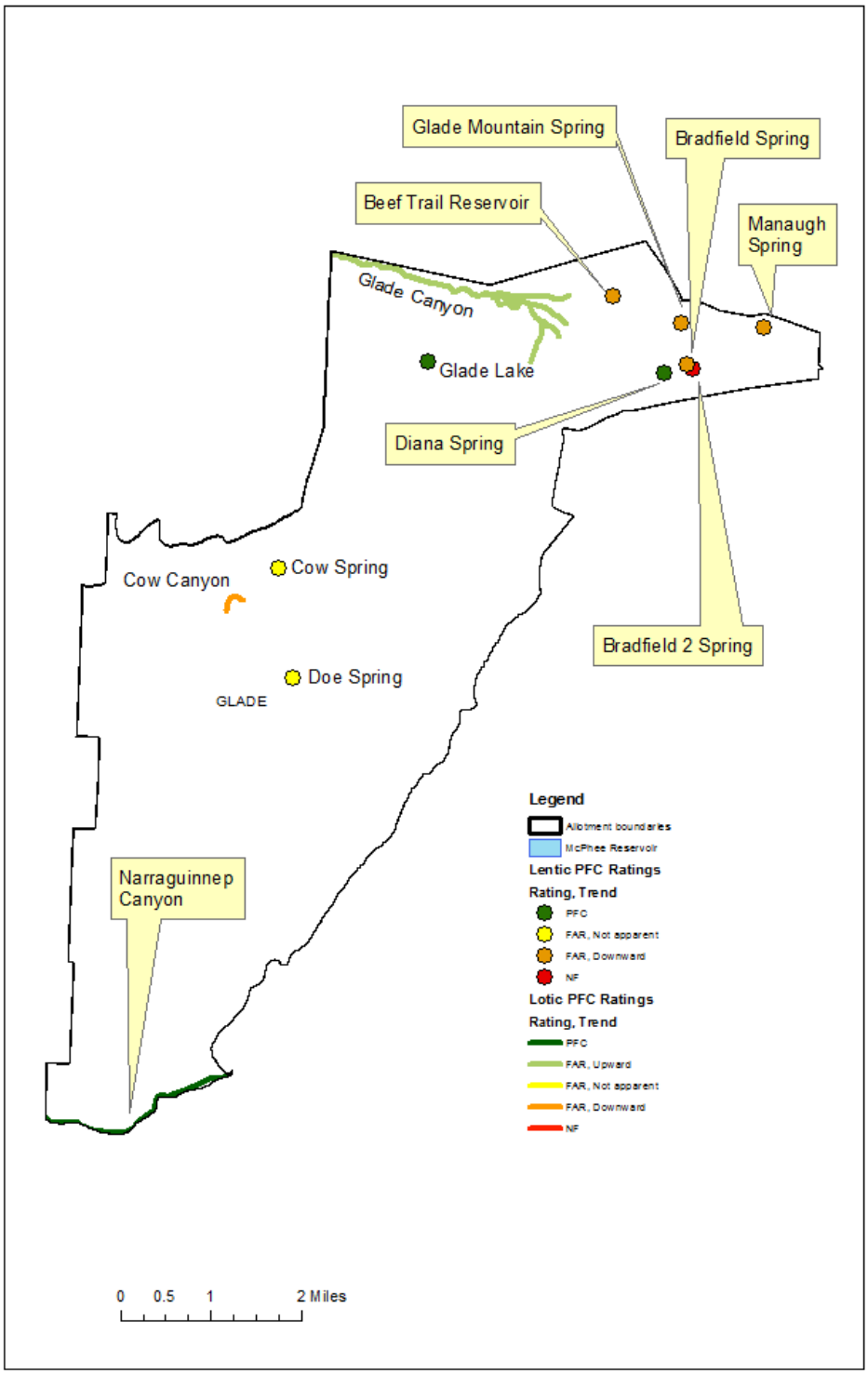
BRUMLEY allotment: PFC assessments



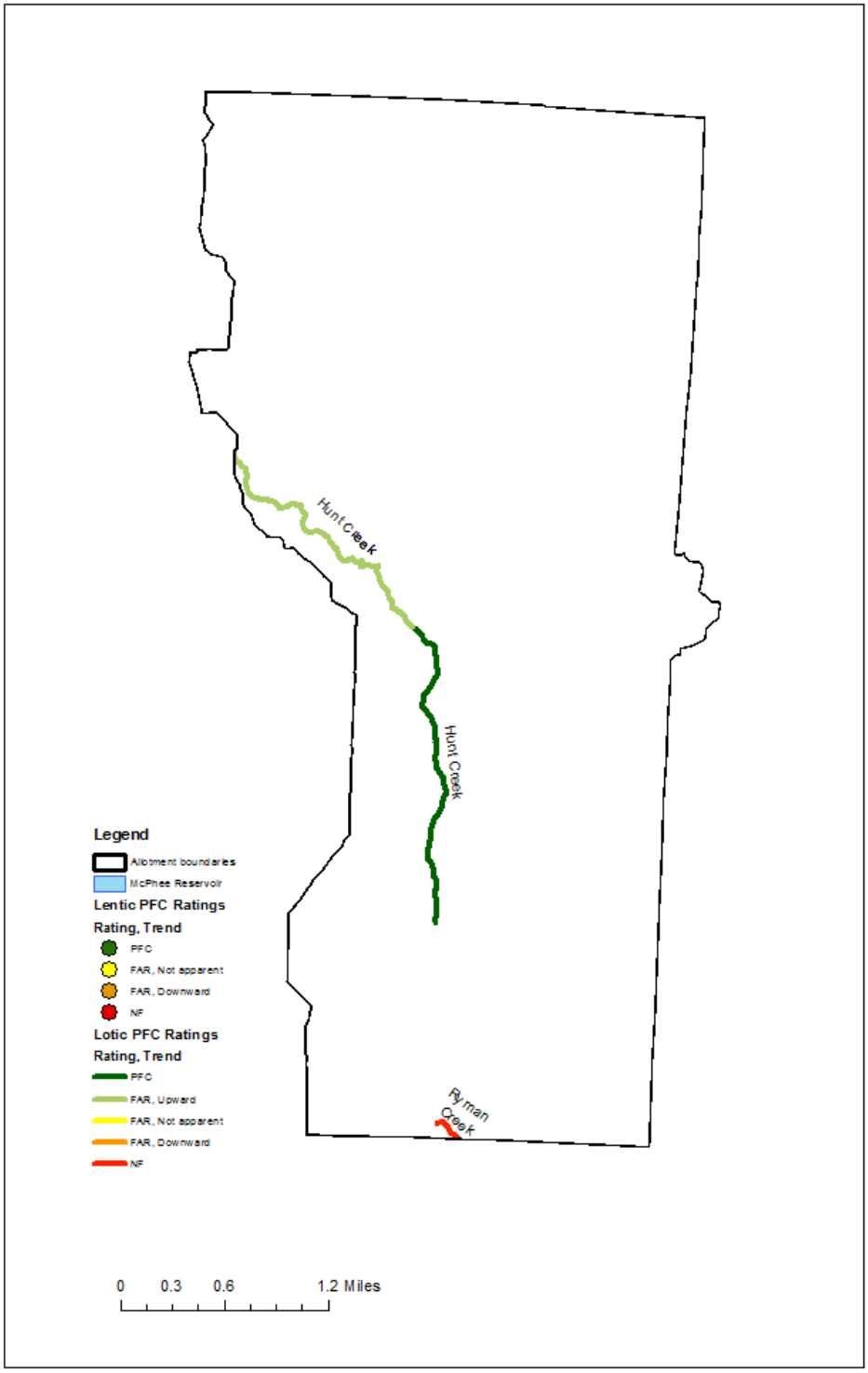
CALF allotment: PFC assessments



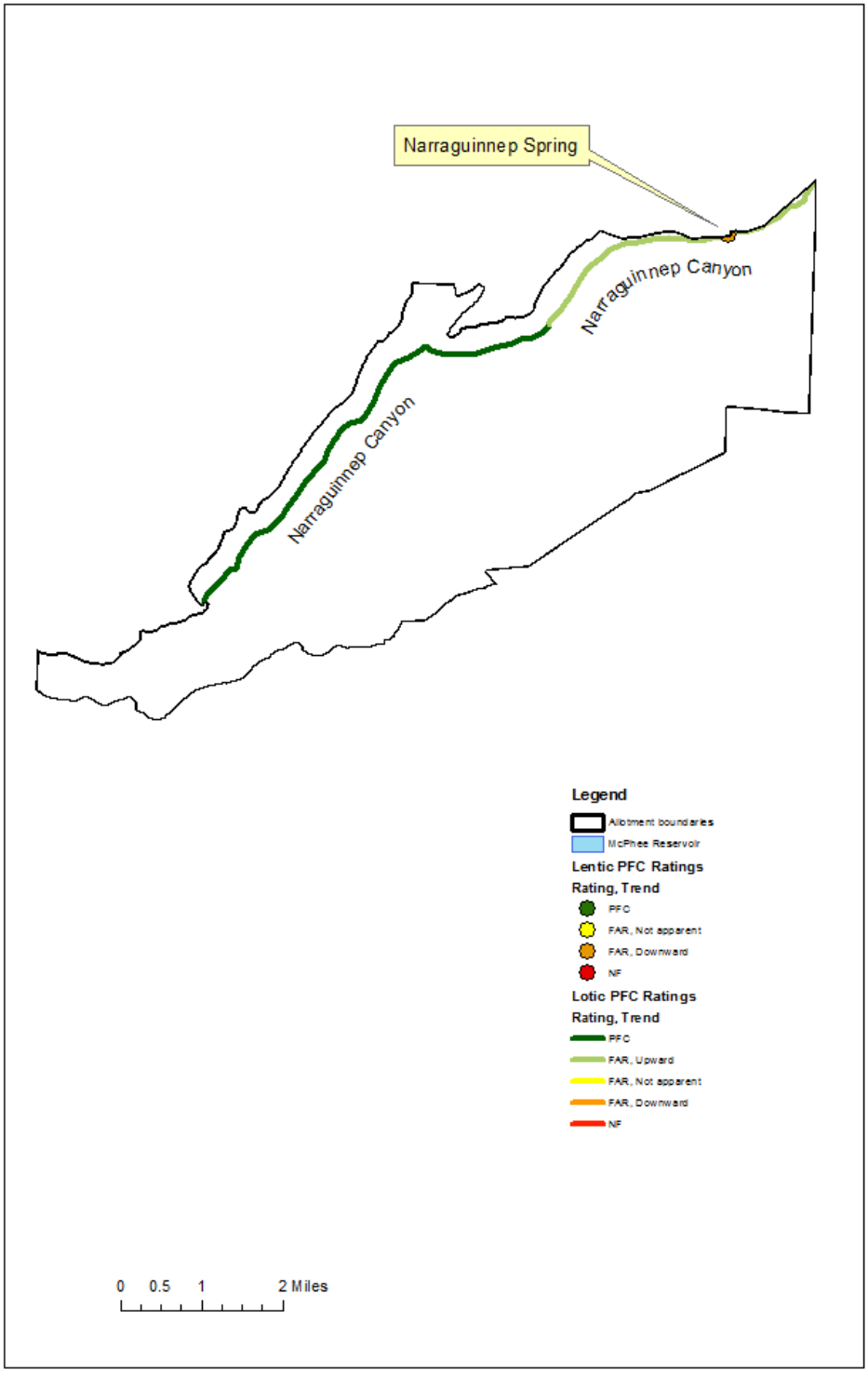
GLADE allotment: PFC assessments



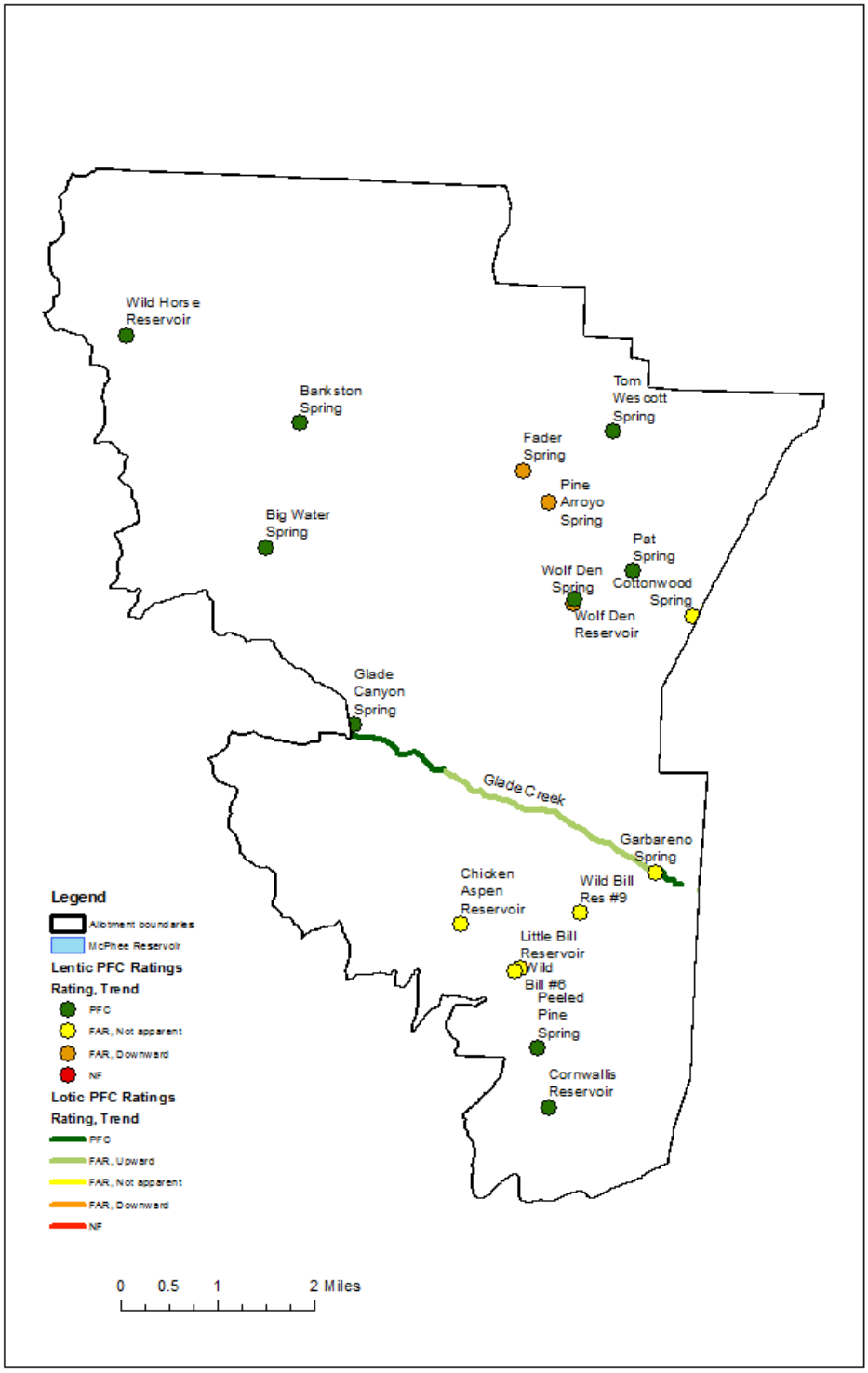
LONE MESA allotment: PFC assessments



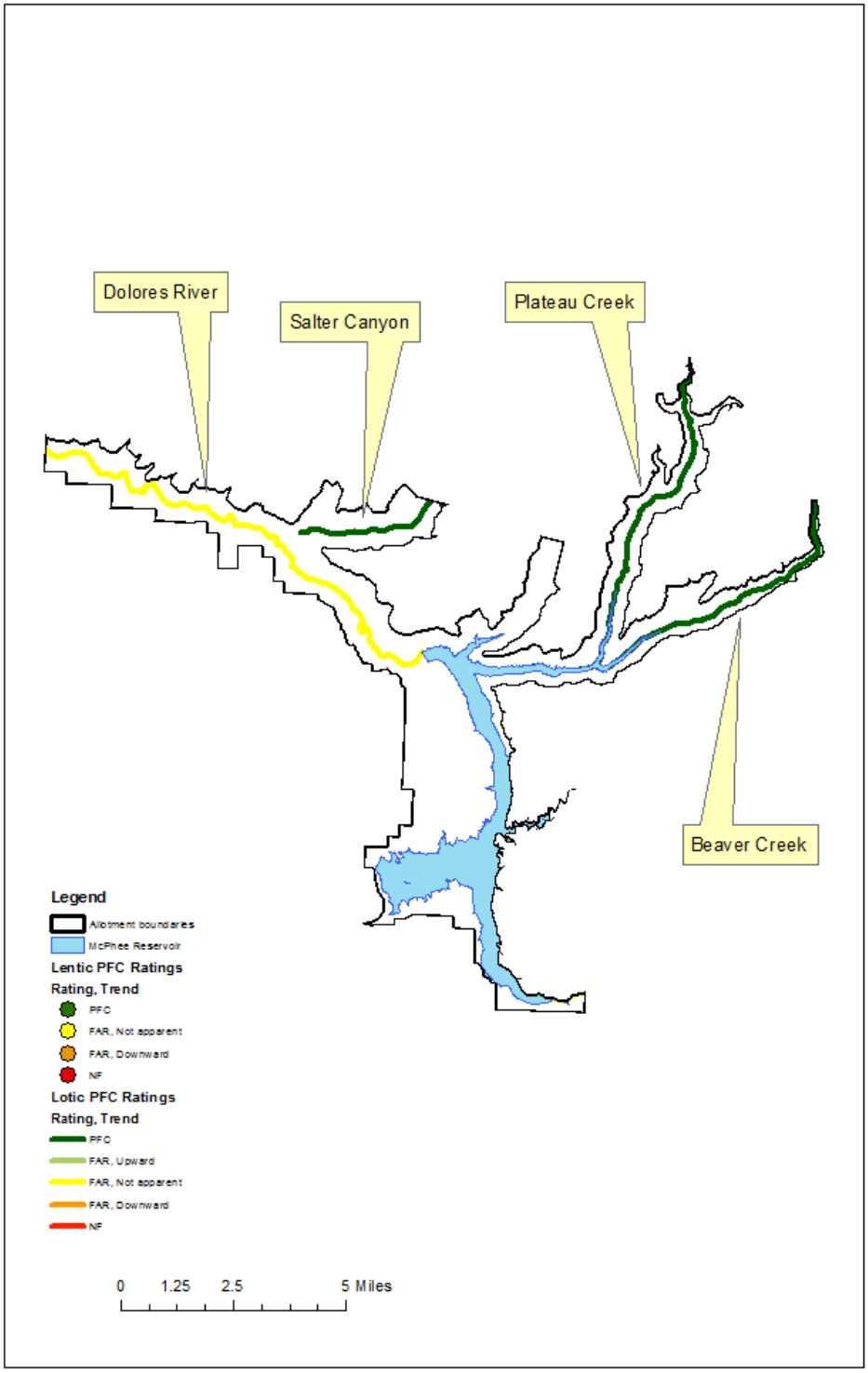
LONG PARK allotment: PFC assessments



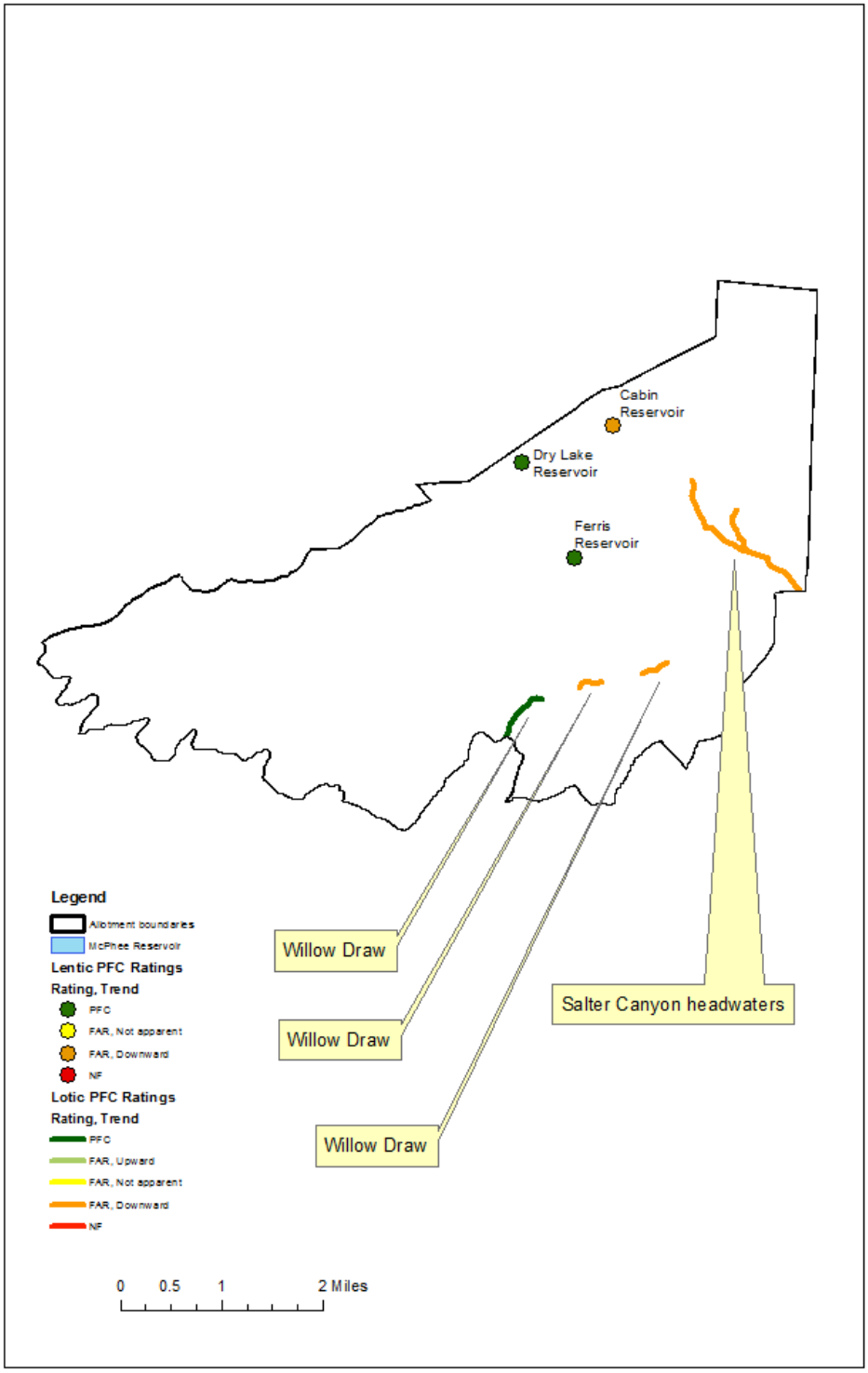
MAIR allotment: PFC assessments



SAGEHEN allotment: PFC assessments

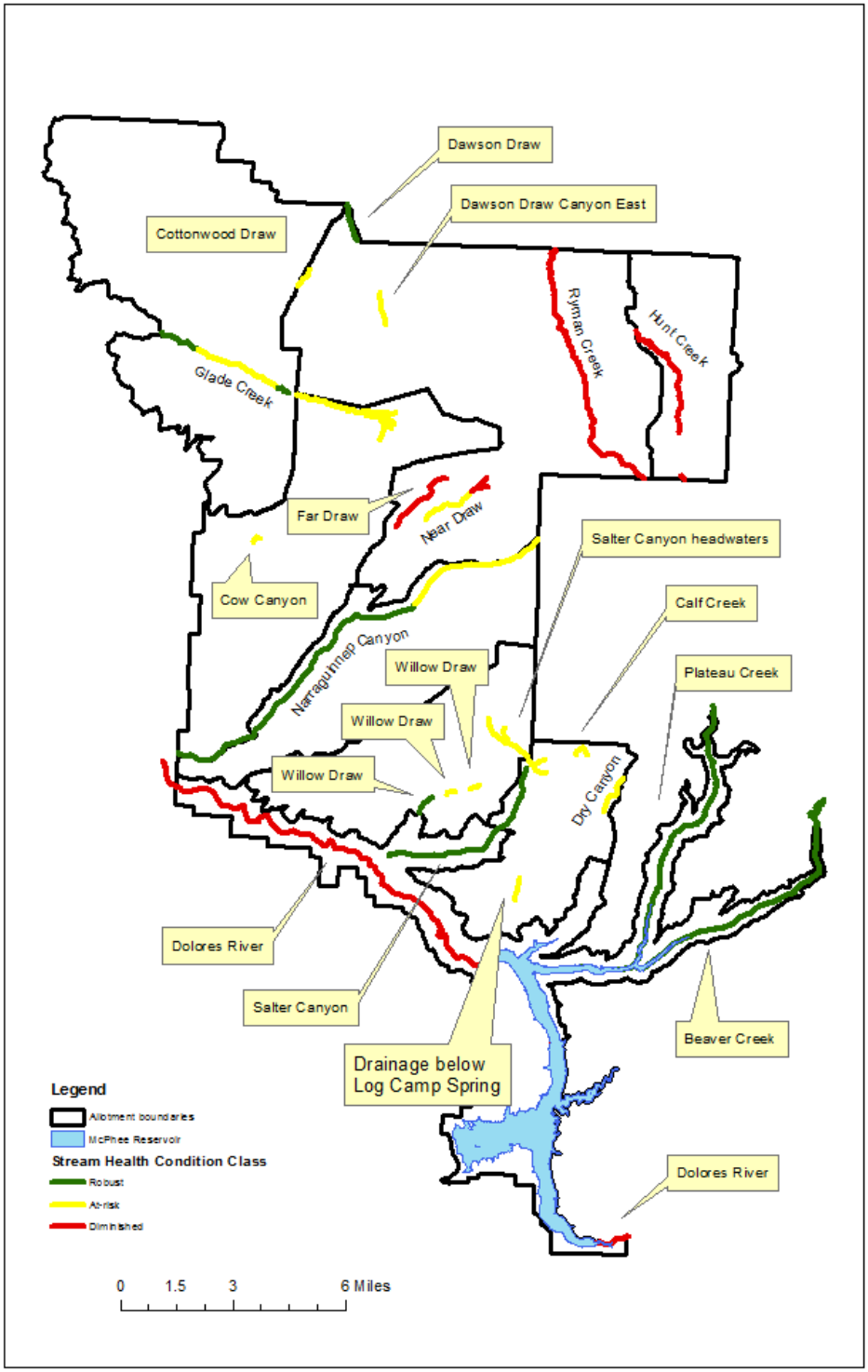


SALTER allotment: PFC assessments

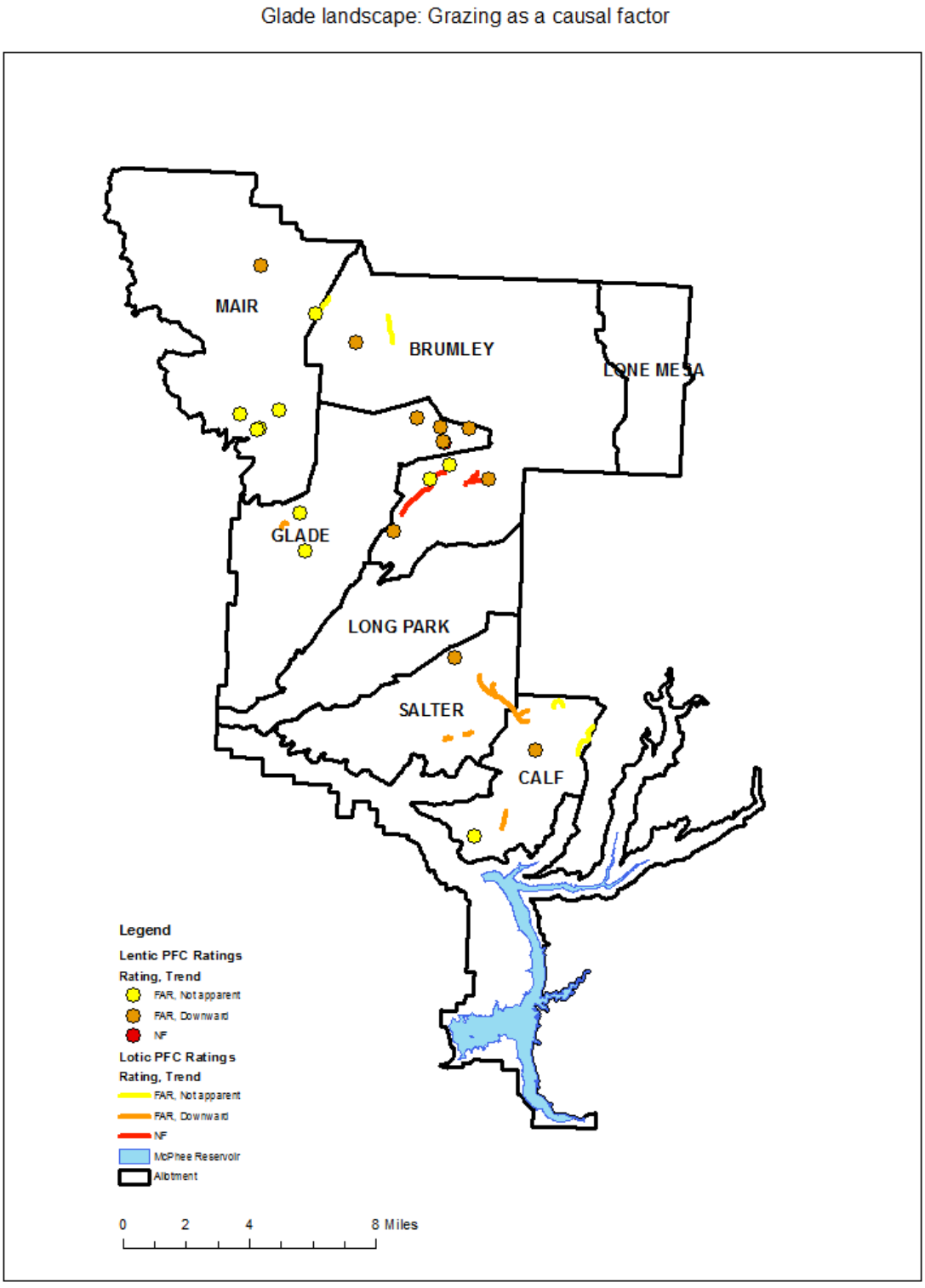


Appendix H Glade landscape: Stream health conditions

Glade landscape: Stream health condition

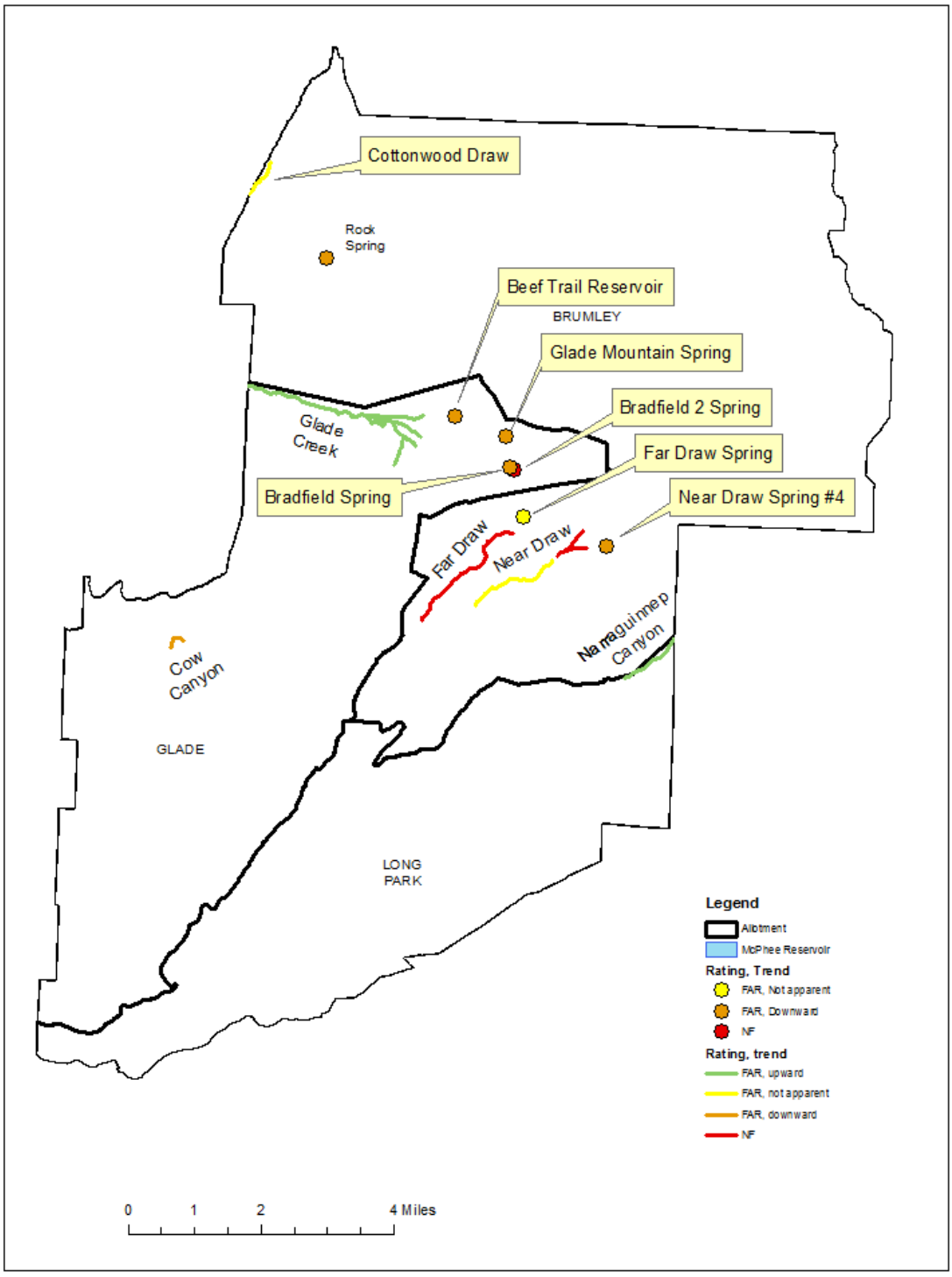


Appendix I Glade landscape: Grazing as a causal factor

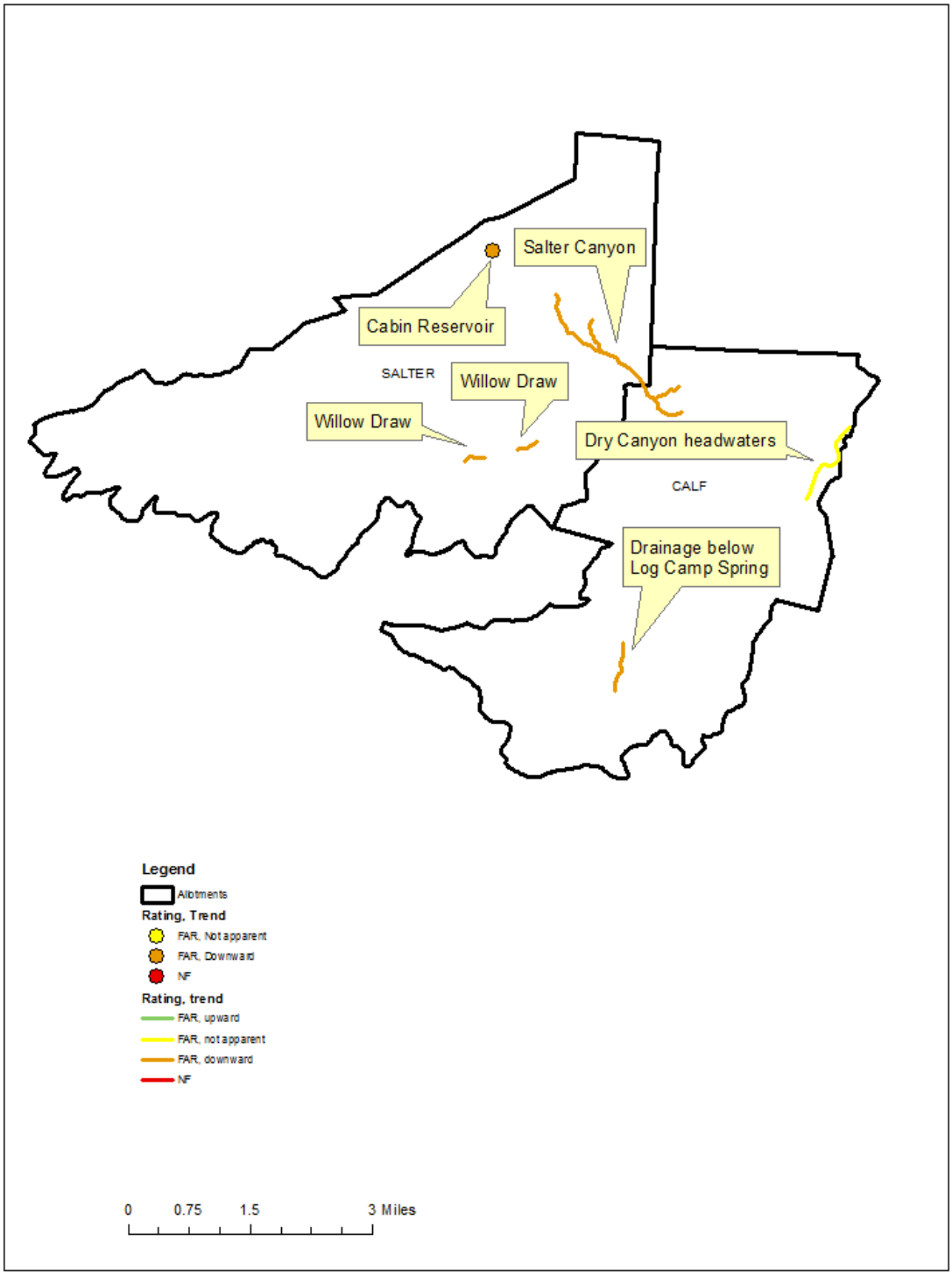


Appendix J Glade landscape: Recommended monitoring locations

BRUMLEY, GLADE, LONG PARK allotments: Recommended monitoring locations



CALF and SALTER allotments: Recommended monitoring locations



Appendix K Glade landscape: Conservation locations